THE BAMBOOS OF ORISSA









Forest Department
Govt. of Orissa

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FOREWORD

Bamboo is one of the most gifted plants available to mankind. Its unique properties as a material of versatile utility have made it more popular since ancient times. Every part of bamboo is utilized in one way or the other. It provides basic necessities of life like fuel, food, shelter and clothing and is also a source of raw material for cottage industry. Bamboo is used for construction, scaffoldings, mats, furniture, fans, toys and umbrellas and for a variety of household articles. It is rightly considered as the backbone of rural economy for the poorest of the poor. Because of its multifarious uses, fast growth, soil-binding properties, and short rotation; bamboo has the potential for economic development of rural people and can become an important activity in poverty alleviation programme.

Bamboo is one of the most abundant renewable resources available in Orissa covering nearly 30% of the total forest area of the State. Development of this sector will provide increased economic opportunities for rural households as also for small/medium enterprise and large industrial development and at the same time improve the overall quality of environment through increased green cover. It can also create sustainable livelihood opportunities through development of bamboo-based production-to-consumption system involving local communities. Adoption of new technologies for production of value-added products would harness the socio-economic development of poor artisans.

However, this resource has considerably dwindled during last few decades due to over-exploitation and adverse biotic factors. The management of bamboo forests is beset with certain inherent difficulties particularly pertaining to premature harvesting for specific uses. The development of resource requires technological interventions for ensuring sustainable production from the bamboo-bearing forests in the state. Besides, production of quality bamboo required for various end uses such as food, handicraft and industries can be promoted through plantation of suitable species in private areas and also by introduction in selected forest areas.

The Book "Bamboos of Orissa" has been complied by Shri B. K. Swain, IFS, Silviculturist, Bhubaneswar after making a detailed study of different species growing in our State. The Bamboos growing naturally in the forest and in the farmer's field in different parts of the State were studied and their identification characters have been streamlined. In the process new bamboo species growing in the State was identified.

The Book contains detailed morphology, uses, method of propagation, pests and disease and the management practices. It also covers the current policy on bamboo, cutting rules and bankable schemes for commercial cultivation. The vegetative propagation method of bamboo has been described along with coloured illustrations. This will facilitate the Forest Department employees as well as the farmers to propagate high yielding bamboos.

It also gives detailed description of 12 bamboo species growing in Orissa. The identifying characters of each species have been illustrated in the shape of coloured photographs. Reference has been made regarding superior bamboo clumps of different species. It is hoped that the book will serve as a reference book for development of bamboo sector in Orissa.

10.03.05

(P. R. Mohanty)
Pricipal Chief Conservator of Forests,
Orissa.

PREFACE

Bamboo, though most commonly used and more frequently seen, often very loosely understood by people. Even for the professionals it becomes difficult in determining the accurate identity of the species, except a few. In the year 1990 S.S.R.Bennet & R.C.Gaur, Botany Division, Forest Research Institute, Dehra Dun published the book "Thirty Seven Bamboos Growing in India" by using young shoots as a tool for identification. In this book characteristic features of young shoots of different species were depicted in coloured plates to facilitate identification. The Kerala Forest Research Institute has also attempted in developing field keys for different bamboo species.

In Orissa we have only few species of bamboo. Even then people baffle to differentiate between *Bambusa nutans* & *Bambusa vulgaris*. Invariably, *Bambusa vulgaris* is regarded as *Bambusa nutans* by many. Due to lack of recognition, the one elegant exotic quietly coming from Burma and growing in village groves of Ganjam and Nayagarh district was not reported so far. Besides, the two indigenous species occasionally found in wild are becoming endangered due to lack of attention of conservationist. Hence, it was necessary to compile a handbook with pictorial illustrations of distinguishable field characteristics – for a guide to identify Bamboo species growing in Orissa.

Large-scale propagation of bamboo is a long-standing problem. Except for *Dendrocalamus strictus*, the seeds of other species are not available regularly. For the two most important cultivated species, the seeds are not only rare but the viability is extremely low. The traditional method of offset planting has limitations of availability and bulkiness. Over the years, different Research Institutes have developed vegetative methods of propagation including tissue culture protocols. But these methods could not be transferred from lab to land. It was necessary to standardize a method of vegetative propagation without involvement of too much of technicality, chemicals, lab equipments etc. so that the rural farmer can practice it easily. Such a method of culm-

cutting-layering has been standardized in Orissa condition for *Bambusa vulgaris* & *Bambusa nutans* and has been described with step-by-step pictorial illustration.

This book is intended to provide useful guidance and practical instructions for identification, propagation, cultivation and management of Bamboos in Orissa. However all the aspects of bamboo in Orissa could not be represented. There are many missing points, which require further study.

Many people have contributed to the compilation of this book. I extend my sincere thanks to all of them. Specific thanks must be given to Sri P. K. Mishra, Sri Bimal Prasna Acharya, Sri P. K. Sahoo and Dr.S. N. Ghose ACFs for their enthusiasm and careful preparation for this publication.

I am particularly grateful to Sri P. R. Mohanty I.F.S, P.C.C.F. Orissa; Sri B. Behera I.F.S, C.C.F; Sri B.P. Singh I.F.S, C.C.F. and Sri R.Nagaraja Reddy I.F.S, C.F. who have ceaselessly inspired and advised for this work.

(B.K. Swain)

CONTENTS

INTRODUCTION

Orissa is like an oval shaped land mass on the eastern coast of India, extending from 17° 49'N to 22° 34'N latitude and from 81° 29'E to 87° 29'E longitude. The total geographical area of the state is about 1,55,707 sq.km. The state has 30 districts, 59 sub-divisions, 324 C.D. blocks, 114 tahasils, 370 police stations, 50972 villages and 125 towns and cities. Physiographically, the state can be divided into four regions: –

Coastal Plain, Central Mountainous Region, Northern Plateau and Eastern Ghat.

The coastline of Orissa stretches over 529 kms. The alluvial delta of six major rivers, namely the Mahanadi, Subarnarekha, Budhabalanga, Baitarani, Brahmani and Rusikulya form the fertile coastal plains and the marshy creeks.

The central mountainous portion with its rolling hills and sprawling valleys covers about three fourth of the entire state.

The high plateaus that are found in the mountain ranges have average elevation of 300– 600 metres and represent characteristics of the peninsular tablelands.

The Eastern Ghat is uplifted in three successive stages with distinct cross section having average summit level of 900,600 and 300 metres. The Eastern Ghat runs from northeast to southwest.

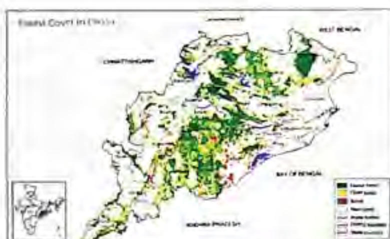


According to 2001 census, the total population of Orissa is 36.71 million out of which the rural population accounts for 85 percent.The coastal districts are more thickly populated than the inland areas. Orissa is one of the few states having high percentage of schedule tribes. There are 62 tribes in the state, accounting for 22.2 per cent of total population. The schedule caste communities comprises of 93 castes and 16.12 per cent of population. About 45 per cent of the state's geographical area has been specified as Schedule Areas. The recorded forest area of the state is 58,135.47 sq.kms, which is 37.34% of the total geo-

graphical area of the state. The per capita forest area in the state is 0.16 Ha. as against the national average of 0.076 Ha. However, the Reserve Forests, managed by the Forest Department, accounts for only 26,329.12 sq.kms. The balance forest area is classified under Demarcated Protected Forests (11,685.68 sq.km.), Undemarcated Protected Forests (3,838.78 sq.km.) and Unclassed Forests (20.55 sq.km). As per the State of Forest report,2001 published by the Forest Survey of India (based on assessment through satellite imagery), the state has 27,972 sq.kms of dense forests, 20,866 sq.kms of open forests and 5,782 sq.kms of scrub forests.

The major species occupying the Orissa forests are Sal, Teak and Bamboo. The species wise classification of forests of the state is:

- Sal forest
  16,938.25 sq.km.
- Miscellaneous forest
  21,024.34 sq.km.
- Teak forest
  2030.64 sq.km.
- Pure bamboo forest
  374.77 sq.km.
- Mixed bamboo forest
  17,794.61 sq.km.
- Mangrove forests
  219 sq.km.



The main forest types of Orissa as per Champion and Seth's classification are:

- Northern Tropical Semi-evergreen Forests.
- Northern Tropical Moist Deciduous Forests.
- Southern Tropical Dry Deciduous Forests.
- Tidal Swampy Forests.
- Dry Bamboo Brakes.

Bamboos, a group of tall arborescent grasses, play an important role in the economy of the country. In the areas of their preponderance, bamboo is intimately linked with the socio-economic development of the rural communities. India, having about 136 species, has the world's richest resources of bamboos. Bamboo has been associated with people since ancient times. Being a natural gift to the mankind, bamboo is very popular due to its multipurpose use, fast growth, easy propagation; soil binding properties and short gestation period as compared to trees. Every part of bamboo is utilized in one-way or the other. It has a high calorific value of 4600 to 5400 cal/kg, which makes it an energy crop. Rural and urban people use it for a variety of purposes. Bamboo provides basic necessities of life i.e. fuel, food, shelter and clothing, particularly to the rural people and is also a source of raw material for cottage, small and medium scale industries. Keeping in view its versatile uses, the potential of bamboo can be harnessed for the service of the poor and for eradication of poverty. Cultivation of bamboo can reduce pressure of fuel, fodder and small timber from forest areas.





MORPHOLOGY

Bamboo is a complex; woody-stemmed perennial grass belonging to family Poaceae.The portion of bamboo below the ground level is called **rhizome**, which forms the vital source for its' perennial growth. Roots are produced by the rhizome and also extend up to the lower nodes of the stems that are below the soil. The tall, cylindrical, persistent **culms** with the branches and leaves form the **clump** above the ground level. The culms and branches during their initial growth are protected by **sheaths**. The leaf blades are flat, multi-nerved, often with transverse veins, usually with a petiole-like base which is articulated with the sheath. Based on the structure and growth characteristics of the clump, bamboos have been broadly categorised into four different forms:





- Tree form: Tall and straight culms with thick walls.
- Straggler form: Medium size culms with the upper portion drooping or arching.
- Reed form: Medium sized, thin walled culms growing gregariously like reed brakes.
- Shrub form: Short and erect culms with very thin walls.

Rhizome

The **rhizome** spreads horizontally beneath the soil and produces both roots and shoots from its nodes. There are two broad types of rhizomes i.e. **sympodial** and **monopodial**. Sympo-



dial rhizomes grow in cluster and form clump by producing buds from their nodes at short intervals in different directions. The bamboo produced from this type of rhizomes is thick and strong. Monopodial rhizomes continue to grow horizontally and produce buds at long intervals and hence do not form clumps. Most of the Indian bamboos have sympodial rhizome. The sympodial rhizomes generally grow at an upward inclined angle. The angle of inclination depends on the species and the condition of soil. Rhizomes may grow in any direction depending upon the soil condition and new culms may appear both on periphery and inside the clump.

New buds are produced from the youngest (one year old) rhizomes. The older rhizomes generally do not take part in the production of new culms. In rare cases, where climatic conditions are very favorable, 2-3 year old rhizomes may produce new culms.



Two kinds of buds are produced by the rhizome i.e. the scaly pointed buds and the flat buds. The former developes into new rhizome below the ground and the later grows above the ground to form a culm.

The number of new culms produced annually by a clump depends upon the health of the clump, soil and climatic conditions. The culm buds



emerge out of the soil immediately after the pre-monsoon showers. However in moist conditions the culms may appear earlier.

Adequate soil cover over the base of the clumps favours the rhizome for growth, development and production of new culms. Exposure to sunlight stops the growth of rhizome. In eroded sites, the production of culm is reduced both in number and size and ultimately the clump growth becomes stunted and congested.



Culm

The buds from the rhizome, which grow above ground are called culms or stems commonly referred to as bamboos. These are hollow (some times solid) cylindrical, jointed and tapering upwards. They may be erect or arching outward after certain height. The joints of the culm are called **nodes** from where the branches and leaves spread. The lower nodes also produce roots. The upper nodes have dormant buds which can grow to new shoots and roots under specific treatment.





During young stage the culms are covered with **sheath** at each internode, which falls off as the bamboo grows. The exposed upper part of the internode is sometimes covered with waxy powder and hairs, which disappear subsequently.

Unlike trees, bamboo does not acquire more diameters as it grow. The new culm emerges with full diameter and it reaches full height in 60 to 120 days. The rate of growth varies between 5cm.per day to 40 cm a day. ***It is said that the bamboos are the world's fastest growing plants.*** Though the culms do not grow in diameter after attaining maximum height, they continue to change in density and strength properties. The successive elongation of the internodes causes height growth. The basal internode is the first to grow and the top-most one is the last. However several internodes grow simultaneously from the bottom upwards and 40-50% of daily height growth is contributed by only 4-6 internodes. The base of an internode is the most active part so far as growth is concerned.



Most of the bamboos have hollow culms. The wall thickness varies from species to species. The strength of bamboo is directly proportional to its wall thickness.





In some localities *Dendrocalamus strictus* and *Bamusa tulda* used to develop solid culms; may be due to edapho-climatic or genetical variations.

The culms are very tender during the early growing period. In certain parts of the state these tender culms are cut to be used as vegetables and pickles. Such practices stop the culm growth and hence restrict the development of the clump.

After the first year, the culms continue to grow tough to reach maturity in the 3rd year. At the age of 3 years the culms acquire the full strength and density. After 5 years the culms start to dry and become susceptible to attack by insects, disease and wind/fire damage.

The growth pattern and structure of **young shoots** vary considerably according to species. They provide very specific morphological characterstics for idendifying different bamboo species. The young shoots of some of the bamboos growing in the state are illustrated below:



Bambusa nutans



B. tulda



B. vulgaris



Bambusa bambos

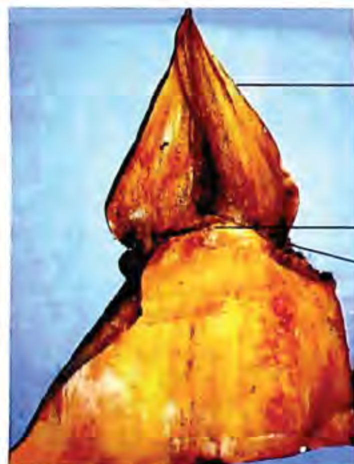


Dendrocalamus strictus

Culm-sheath



Culm sheaths are modified leaves, **arranged alternately** on opposite sides of the growing culms, providing protective cover for the young shoots. The sheath is attached to the node, clasp the culm and falls off leaving a scar after the culm becomes mature. Width of the sheath is greater than the circumference of the node so that the two sides of sheath overlap. The back of the sheath is usually covered with hairs that are irritant and easily detached when sheaths become old. The inner side of the sheath is smooth and shining. Early removal of culm sheaths will result in stunted growth of the culm.





Apart from its main protective body, the culm sheath consists of a **blade, auricles and ligule**. The distinct portion at the top of the sheath is the blade. The blade is smaller at the base of the culm and larger and leaf-like to wards top. The blades may be erect or deflexed and are deciduous when the sheaths become old.

In some bamboo species, prominent ear-shaped structures are present at the point of attachment of the blade on the sheath. These laterally extended structures are called **auricles**; which play very important role in identification of bamboo species. The auricles may have hair-like bristles on their edges. The auricles are not deciduous but are fragile and easily broken.



The thin, short upward-growth on the inside top of the sheath, which clasps the culm is known as **ligule**. The shape, height, margin of the ligule and presence of hair etc. are some of the characteristics facilitating identification of bamboos. These characteristics are more prominent in young culm-sheath.



The general appearance, size and shape of culm sheaths, the structure and character of blade, auricle and ligule are considered as the best guide for identification of bamboo species.

Branching





Branches emerge from the nodes and are arranged on alternate sides of the culm. The number of branches at each node varies according to the species. Normally one main branch and two or more secondary branches emerge from each node. The main branch is thick and long as compared to other auxiliary branches. In some species, branching is absent in the lower nodes up to a considerable length. However, in some other species branching starts from fourth internode above the base. Incase of few thorny species the lateral branches are hardened to spines providing natural armour to clumps.

The branches and branch-lets bear profuse leaves. In many cases the branching pattern is considered as a characteristic for the genus.



Flowering

Like other plants, bamboo does not flower annually. In general, flowering and fruiting occurs only once during the lifetime at certain age of the clump after which it dies. The flowering cycle of bamboo varies from 7 years to 60 years depending upon the species. There are 3 different types of flowering.

- Annual: The culms remain healthy after flowering.
- Sporadic: Only some clumps in an area flower, bear seeds and die thereafter.
- Gregarious: The whole population of bamboo, over an extensive area, flower over a period of time and die out.

Generally most bamboo species flower gregariously at fixed intervals and all culms including those of current year die after flowering. The Bamboo clumps belonging to a particular stock flower simultaneously. It has been reported that the entire population of a given species raised from the same seed source, no matter where they are situated, would flower at the same time. As a precaution, it is required to raise bamboo crop of different species to ensure constant supply of bamboos. In Salia bamboo (*Dendrocalamus strictus*) that is predominant in Orissa forests, both sporadic and gregarious flowering occur at long intervals of 20–65 years.



Flowering in *Dendrocalamus strictus*



Flowering in *Bambusa nutans*

Flowering is very rare in the two important bamboo species cultivated by villagers i.e. *Bambusa nutans* and *Bambusa vulgaris*.

Fruit and seeds

The fruit of bamboo is an indehiscent, one-seeded caryopsis. The size and shape of bamboo fruit (seed) vary according to the species. The seeds have no dormancy and hence can be sown soon after collection to get higher percentage of germination. The seeds are also used as grains during scarcity period.

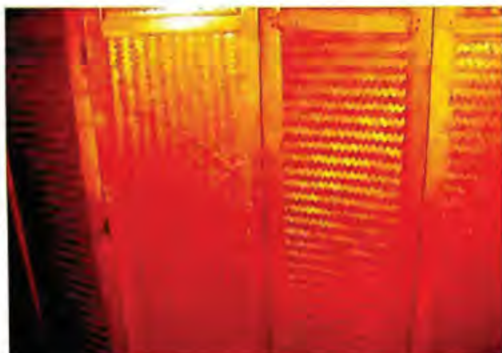


USES OF BAMBOO

Bamboo, **the poor man's timber** is a strong, versatile and renewable woody material having multifarious uses both in rural and urban sector. It has been an integral part of India's' cultural, social and economic traditions. Millions of people depend on it for their livelihood and for household and functional uses. The unique properties of bamboo; such as its strength, straightness, smoothness, durability, easy to cut and split, easy to carry; have made it useful to the villagers in almost every need of life. Besides being an essential component of cottage and rural industry, bamboo is also found to be used in some specialized uses such as tube well pipes, artificial limbs, and reinforcement in cement concrete etc.

The Indian Plywood Industries Research and Training Institute **(I P I R T I)**, Bangalore has developed many innovative products such as bamboo mat boards (BMB), bamboo mat veneer composites (BMVC), bamboo mat corrugated sheets (BMCS), bamboo mat tray (BMT), bamboo laminates and bamboo match sticks etc. by using bamboo as the raw material.





Banslochan (Tabasheer) a microscopically fine silicaceous matter found within the inter nodes of some bamboo species is used in Ayurvedic drugs to treat cough and asthma. Other parts of bamboo such as roots, leaves, sap and ash are used to treat a number ailments like cough, bile, fever, swelling, cuts, ring worm, bleeding gums and wounds etc.

However, the major commercial use of bamboo in Orissa has been for paper industries. Bamboos from forests were being supplied to Paper Mills of the State. As two of the four paper mills have been closed down and the other two have started using higher percentage of hard wood as raw material; the bamboos harvested from forests do not fetch good market at present.

Bamboos are used by man from the "cradle to the coffin". It is the nature's most valuable gift to mankind, especially to rural people.







The important **characteristics**, for which bamboo has been considered as the most cost effective woody material, are:

- It has got a fibrous structure and the fibers are longer as compared to wood.
- The strength properties are better than many timber species.
- The circular and hollow cross-section of bamboo gives it a high strength-weight ratio.
- Bamboo is elastic in comparison to wood.
- The cross partition wall at each node make the bamboo strong and hard to bend or break at joints.
- It has a smooth and clean surface.
- It can be easily cut into required size and split-up into strips with house hold tools.
- Bamboo culms can be easily stored and transported.
- Ordinary methods of seasoning and treatment such as submerging in water can increase its durability.
- The culm growth is faster and matures within 3 years.



Because of easy workability and low costs, **bamboo has been useful to the general mass**. The rural people use bamboo for house construction, walling of hutments, thatching and roofing, basket making, poles, posts, agriculture implements, tool handles, scaffolding, bed frames, cradles, ladders, pickle (food), cart yokes and bodies, bows and arrows, walking sticks, furniture, fencing, fishing rods, sieves for cleaning grains, container for pounding and storing grains, pipes, fuel, fodder, making water and oil container, musical instrument, umbrella handles, rickshaw hoods, aggarbati sticks, tent poles, boat plying rods, etc. Rural women use the culm sheaths as plaited shoes on festive occasions (the Raja festival in Keonjhar and Mayurbhanj districts).



Fancy products from Bamboo





The use of bamboo for various applications depends upon the age of the culm. The preferences are:

- Less than 30 days – for food
- 6 months to 1 year – for making baskets and fancy articles
- 1 to 2 years – for bamboo board & laminations
- 3 to 5 year – for construction purposes
- More than 5 years – bamboo gradually loses strength and dies

Since there is a great demand of bamboo shoots for food and a sizeable population of the state are engaged in bamboo craft for their livelihood, the management principles of the State Forest Department should take these factors in to consideration.

BAMBOO AS FOOD

Bamboo shoots are tender when young. The shoots are addible if harvested before they reach 30 cm in height, generally within a month from sprouting.

The young shoots are crisp, mild-flavoured and are a popular ingredient in a variety of Asian dishes. Though commonly, steamed bamboo shoots are marketed canned in Japan, Thailand etc., fresh bamboo shoots are far superior in taste and texture. Fresh bamboo shoots can be stored for up to two weeks in the refrigerator.

Bamboo shoots are low in calories and fat, containing only 14 calories and 0.5 g fat per half-cup serving. The same size serving also provides 2.5 g fiber, about one-tenth of the recommended daily amount, which helps lower cholesterol and is a valuable defense against colon cancer. Bamboo shoots are also rich in potassium: one cup contains 640 mg of potassium (18% of the recommended daily amount) which plays a important role in maintaining normal blood pressure and heart rate.

Fresh bamboo shoots must be cleaned and cooked before eating. Raw, they are bitter and difficult to digest. The general method of preparation is to cut off the root ends, remove the tough outer leaves and pare away any tough fibrous sections before cooking. Slice the bamboo against the grain into 3 mm slices. Very tender shoots can be sliced in any fash-



Karadi
(sliced)

ion. Drop into boiling water and cook for about 20 minutes uncovered, to allow bitter substances in the bamboo to dissipate. Bamboo shoots that are still bitter after cooking can be given a second cooking in fresh water for approximately 5 minutes longer. To microwave bamboo shoots, place them in a shallow pan of water and cook uncovered for four minutes. Bamboo shoots should remain slightly crisp once cooked.

In our state the new sprouts of bamboo culms (***Karadis***) are procured from forests by local people to prepare pickle and food beverages. The fresh young shoots are sliced and fried to prepare the dish. It is also added to other dishes made from tomato and lady's finger to add to taste. Since the shoots are available only during rains, the villagers convert the young shoots to small pieces like noodles, dry it and store for the rest of the year. The dried shoots are called *Hendua*. **Hendua** is added to a number of dishes prepared from vegetables and fish to have a special flavour. The demand for *karadi* is so much in certain parts of the state that large quantities of young sprouts are removed from forests, leading to absence of new shoots and depletion of bamboo stock.



Hendua

Bamboo culms are also used for preparing special dish of roasted meat. The hollow internode of big size Daba bamboo (*Bamboosa bambos*), with both the cross partitions intact, is used for this purpose. A hole is made in one of the cross partitions to stuff meat from one side. The meat is cut into small pieces, marinated with required quantity of oil, spices and condiments and kneaded for about 20 minutes for softening. The meat so prepared is then stuffed in side the lumen and the hole is closed with a small wooden peg. Two-centimeter thick clay is rubbed over the entire internode and then grilled over the radiating charcoal heat for about half an hour. When the clay becomes red hot the meat is supposed to be ready to be served. It is said that the taste of such roasted meat is excellent.

BAMBOO ARTISANS

Bamboo has been a potential source of raw material for a large variety of handicraft items. In North-Eastern states the handicraft industry utilising bamboo as raw material has opened lots of avenues for employment for the local people. The craft products made from bamboo are the toys, mats, wall plates, curtains, wall hangers, hats, fans, trays, pen stands, photo frames etc. Dry bamboo rhizomes are also used for preparing decorative handicraft items. In Orissa, though there is scope, the handicraft industry has not grown up to the expectation. Some sporadic attempts have been made here and there. But due to lack of organised marketing for these products many such initiatives have failed.

In Orissa certain **traditional communities** have adopted the bamboo craft as a profession for their livelihood. Most of them are landless and do not have any other source of earning.





The bamboo artisans **procure bamboo** by themselves **from nearby forests**. The frequency of visit to forest for extraction of bamboo depends on the closeness of the forests as well as the quality of bamboo available.

The artisans living in towns or villages away from forests have to purchase bamboo from others, who procure those from forests. This adds to the cost of production and reduces profit. The price of bamboo varies depending on the distance from forest. **They usually prepare baskets, mats and other household items**, which are normally used by the local rural households and hence the income generated is very low.



Some of the artisans have developed specialization in making fancy articles. The mats prepared from the epidermal layer fetches higher price for being used in beds. Similarly the baskets prepared from this layer are sturdy and carry a premium price. Because of this, in some pockets, the artisans remove the epidermal layer of bamboo during collection in side the forest, reject the whole inner portion and carry enough quantity of top layer in cycle required for the week. Such uneconomic use of bamboo causes lots of wastage and depletion of resource. Local artisans generally use 1–2 year old bamboos for their products. In most cases, they harvest bamboo from the lower reaches of the forests causing over exploitation and ultimate degradation of the crop. A set of rules framed by the state namely **"Supply of Bamboo to Artisans including Co-operative Societies (Orissa) Rules, 1980"** (Appendix-B) could not help much as the official harvest of 3-4 year old bamboos are not preferred by the Artisans. Though a large number of people, mostly belonging to scheduled caste communities, are engaged in bamboo related activities no estimation has been made to assess their requirement.

The mats and baskets made by the artisans are generally sold in the nearby weekly markets.



Bamboo artisans in towns and cities display and sell their products in front of their huts.



Sometimes, they move around in the towns and villages to sell. Petty traders are also involved in procuring fancy items from the artisans for selling in fairs and festivals and other places. Invariably these artisan communities are at the lowest rung of the social hierarchy. Over the years, with gradual depletion of bamboo resource from nearby forests and introduction of new, competitive materials in the market, the income of artisan communities has suffered a lot. The average monthly income of a bamboo artisan family ranges from Rs.700 to Rs.1000 . The income is more during harvest season and summer due to increased demand.



Due to such low income, the younger generations are not attracted to this profession. Many of them have shifted to other jobs. **Only the older generation and the women of the family are carrying on with the activities as a livelihood option.**



Technological and financial interventions are required to improve the present condition of artisans. They should be encouraged for adopting scientific harvesting methods and prophylactic treatment of their products. Marketing tie-ups for industrial applications of bamboo composites and crafts can enhance their economic growth.

BAMBOO DISTRIBUTION

India has the largest resource of Bamboo in the world. There are about 136 species under 22 different genera available in various parts of the country (Sharma, 1980). Bamboo in India occurs in a wide range of habitat starting from sea level up to 3,500 Mtrs. Bamboo is an important associate of tropical and semi-tropical moist deciduous and occasionally semi evergreen forests and occupies 9.7 million Hectares of forestland, besides the homestead and private plantations. It favours a well-drained soil and cooler aspect.

Bamboo is largely concentrated in North-Eastern region, Western Ghats, Andamans & Nicobar islands. It is widely distributed in Andhra Pradesh, Arunachal Pradesh, Asam, Chatisgarh, Karnataka, Kerala, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Sikim, Tripura and West Bengal.





The region-wise Bamboo distribution in India is given in the following table:

Region	No of Genera	No of Species	Diversity Represented
North-eastern India	15	56	Arundinaria(9) Bambusa(12), Cephalostachyum(5), Chimonobambusa(6), Dendrocalamus(7), Dinochloa (2), Melocanna(1), Neohouzeaua(2), Oxytenanthera (2), Phyllostachys(2), Pseudostachyum(1), Semiarundinaria(1), Sinobambusa(1), Teinostachyum(1), Thamnocalamus(4).
North-western India (Eastern & Western Ghats)	5	14	Bambusa(4), Chimonobambusa (2), Dendrocalamus(4), Phyllostachys(2), Thamnocalamus(2).
Indo-Gangetic Plains	4	8	Bambusa(4), Cephalostachyum (1), Dendrocalamus(2), Oxytenanthera(1).
Peninsular/South India	8	24	Bambusa(3), Cephalostachy(1), Cimonobambusa(1), Dendrocalamus(1), Indocalamus (3), Ochlandra(9), Oxytenanthera(5), Tainostachyum(1).
Andaman & Nicobar Islands	6	7	Bambusa(2), Cephalostachy(1), Dendrocalamu(1), Dinochloa(1), Oxytenanthera(1), Schizostachyum (1).

Source: Thomas *et al.*, 1985

In Orissa we have only a few bamboo species, some are indigenous and other introduced and cultivated. The most common and dominant bamboo species of Orissa is *Dendrocalamus strictus* commonly known as *Salia* bamboo, which occurs naturally in forests mostly on hill slopes. Next to it is the *Bambusa bambos* growing in patches in moist valleys in the forests and village wasteland. The other species that are found naturally in the forests, in specific pockets and also to a limited extent are *Gigantochloa rostrata* and *Schizostachyum pergracile*.Besides, *Bamusa vulgaris* and *Bamusa nutans* are commonly planted in the homestead lands by the villagers. *Bamusa tulda* and *Thyrsostachys oliveri* are occasionally planted. Few other species are occurring here and there and in research gardens of Forest Department.

The bamboo **species available in Orissa** can be broadly classified in to four different categories:

- Occurring naturally in the forests: *Dendrocalamus strictus(Salia), Bambusa bambos (Daba)*
- Cultivated by villagers in their homestead land: *Bamusa vulgaris (Sundarkani), Bamusa nutans(Badia)*
- Found in small numbers in specific locations either in forests or in village land: *Schizostachyum pergracile* (*Dangi*) *Gigantochloa rostrata* (*Pani bans*), *Thyrsostachys oliveri* (*Nala bans*), *B.tulda* (*Taleda*),
- Occurring as very few individuals: *Bambusa striata*, *Bambusa wamin*, *Dendrocalamus giganteus*, *Thyrsostachys regia*.

Bamboos Found in Orissa

SALIA BAUNS
***Dendrocalamus strictus* Roxb**
Bambusa stricta Roxb.

This is the most gregarious natural bamboo of the state. Generally a deciduous and densely clumped species. **Culms** 6–10 m high and 2.5–4 cm in diameter, grayish green with white powdery patches when young, dull green on maturity, arching outwards above half of its height; nodes usually swollen, basal nodes rooting. Internodes 20–30 cm long, thick walled usually with a small lumen or at times fully solid.



Culm-sheaths variable, lower ones shorter, upper ones oblong, 7.5 – 30 cm long with brown stiff hairs on the back, at times glabrous in dry localities, occasionally striate when young, top rounded or wavy, margin hairy, only slightly auricled; sheath-blade lanceolate, triangular, hairy on both sides, with a very narrow and toothed ligule. Leaves narrowly oblong or linear-lanceolate, up to 25cm by 3cm in moist localities but smaller in dry areas, rounded at the base and suddenly contracting into a short petiole, gradually narrowed upwards into a twisted sub cuspidate top. Leaf sheaths striate, hairy or glabrous.

Young shoots ashy green, very thickly covered with dark brown hairs, gradually tapering to a pointed apex, sheaths imbricating, auricles not visible.

This species occurs naturally in the forests of the entire state except in Mayurbhanja, Keonjhar and Nawarangpur districts. Very often it is also planted by the villagers in their home stead land. In nature, based on culm size and wall thickness, three different variants of Salia bamboo have been observed.

(a) Tall culms with moderately thick walls and a small lumen generally found in moist hill slopes of Ganjam and Phulbani districts.

(b) Culms of medium height, fully solid or nearly so and of 3-4 cm in diameter.

(c) Culms with larger lumen and thin walls generally found in depressions and dry areas.

USES: Suitable for a variety of purposes such as construction, agricultural implements, musical instruments, furniture, mats, baskets and above all paper & pulp. Young shoots are commonly used as food.

D. strictus



Salia Bamboo in Forest





The Culm









Flowering



Leaf



Young Shoot







Culm-Sheath

KANTA BAUNS

***Bambusa bambos* Voss.**

Bambusa arundinacea Retz.

A large thorny bamboo forming dense clumps from a thick rootstock. **Culms** are bright green, shining, up to 18–20 m. high and 10–15 cm in diameter. Branching starts from the base. The lower nodes gives out long curving and drooping branches armed with recurved thorns. The upper branches bear leaves with smaller thorns.



The zigzag thorny branches completely encompass the clump making it difficult to remove a culm from the tuft. Internodes are 25 to 35 cm long, fairly thick walled and with large lumen. **Culm-sheaths** up to 30–35 cm long, 22–25 cm broad, coriaceous, mostly glabrous, somewhat rounded at the top and plaited on the edges. Sheath blade broadly triangular, up to 10 cm. long, shortly pointed, margins decurrent on the sheath, the inner surface having dense brown to black hairs.

Young shoots purplish-green with yellow tinge, glabrous, sheath blades recurved and the apex blunt.

Leaves relatively small, linear or linear-lanceolate, slightly pubescent beneath, usually 12–20 cm. by 1.2 – 2cm., often very small leaves occur at base of twigs; leaf sheaths pubescent or glabrous.

This species grows essentially in moist valleys, forming dense gregarious crops in the vicinity of rivers, often planted in village wasteland and in fence.

Two variants of this species are noticed in Orissa: one being very tall with large diameter and lumen (Daba) and the other producing medium sized but thick walled culms. The former is seen in moist valleys in semi-evergreen forests and the latter in lateritic soil. Mr. H.H. Haines reports in "The Botany of Bihar and Orissa" that Mr. Gamble had recorded three separate varieties of this species based on floral characteristics. Subsequently Bennet & Gaur in "Thirty Seven Bamboos growing in India" (1990) have differentiated the larger variety as *Bambusa bambos* Var. *gigantea*. They have mentioned that the general appearance of the young shoot of this variety is quite distinct from the typical *Bambusa bambos* found almost through out India. The illustration of the young shoot of *Bambusa bambos* Var. *gigantea* given by Bennet & Gaur compares well with specimen found in moist valleys of Berbera forests of Khurda Forest Division. However, further study is required to decide the taxonomical status of these variants.

USES: The most common use is for paper & pulp. A very good bamboo for rafters, scaffolding, roof thatching, making baskets, furniture, etc. The spiny branches are used for fencing. Young shoots are edible. Wild animals particularly elephants and gaur relish the young shoots in forests.

Bambusa bambos



The clump



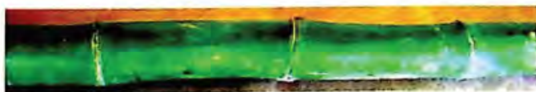
Leaf



Thorn



Branching







Culm



Young Shoot





Culm-Sheath





Young Shoot of Berbera specimen



Young shoot eaten by Gaur

SUNDARKANI
***Bambusa vulgaris* Schrad.**

A commonly cultivated, moderate sized bamboo. **Culms** 10–15 m high, 5–10 cm. diameter, green and glossy when young, turning yellowish afterwards and often with yellow strips; invariably arching outwards beyond a certain height. Nodes prominent, lower ones having rootlets; internodes 20–40 cm long, wall thickness vary from 0.8–1.4 cm.



Culm-sheaths 15–25 cm. long, 20–30cm. broad, often streaked yellow, densely covered with thick appressed dark brown-black hairs above, top rounded; sheath-blade 5–12 by 10 cm., spatulate, yellowish when young, turning to somewhat triangular with acute apex latter; thickly hairy in side, base decurrent and lower margins having curved bristles. Ligules continuous with the top of the sheath, dentate or at times entire. Auricles prominent, sub equal, falcate, sickle shaped with a notch at the base and having stout curved bristles. Much of the branching starts above 3–4 meters from the ground level; branchlets yellowish-green. Leaves 15–25 by 2–4 cm., lanceolate, glabrous, margins scabrous, leaf-sheaths laxly, with ciliate auricles.

Young shoots are dark brown to yellowish green; sheath greenish and covered with dark-brown hairs on upper two-third; blades erect, yellowish, auricles distinct, shoot tip broadly pointed.

This bamboo is most widely cultivated in homestead lands through out the state. The culms being loosely packed are easy to extract and hence preferred by the people. However, **three variants** of this species have been observed in farmlands. One having very tall culms of bigger diameter, but much hollow inside, arching above two-third of its height and splits when dry if left in the clump. The second is of medium height, thick walled, comparatively erect but arching towards top, glossy green, superficially and utility wise much resembles with *Bambusa nutans*. The third variant has culms of 6–8m. high, 4–5cm. diameter and very much arching from the mid height. Two very large size clumps of this species having culms up to 20m height and 8–12cm diameter has been noticed: one in Phiringia Range office campus of Phulbani Forest Division and the other in Barigaon village near Gudgudia in Karanjia Forest Division. Further study is required to ascertain the actual genetical variation.

USES: It is extensively used for construction purpose, also for scaffolding, thatching, poles, agricultural implements, manufacturing of household articles and handicrafts. The artisans prefer this bamboo as compared to Salia bamboo.

Bambusa vulgaris



The clump



Branching



Culm

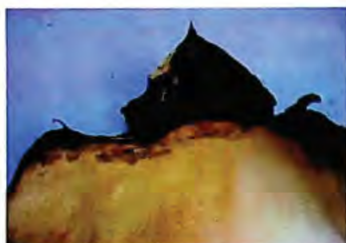


Young Shoot



Leaf









Culm-Sheath



A small clump

BADIA BAUNS
***Bambusa nutans* Wall**

A big-sized, luxuriant, cultivated bamboo. **Culms** 10–17 m. high, 6–8 cm. in diameter, loosely clumped, much branched above, less branched below, straight, green, smooth, often with a whitish ring below the nodes; nodes slightly thickened, lower nodes bearing thick rootlets, internodes 25–40 cm. long, walls 0.8–1.2cm thick.The white rings below the nodes are distinct in young culms of two-six month old along with powdery patches on the internodes.In older culms these white rings are not visible.



Culm-sheaths 15–25 cm. long, up to 30 cm. wide at the base, densely covered with appressed black hairs on the back, top truncate; sheath-blade triangular-acuminate; ligules entire, auricles two, at the top of the sheath, large, wavy, unequal, one erect and the other decurrent, having curved bristles. The auricles are not distinct in first few lower culm-sheaths. The wavy auricles develop in culm-sheaths at a height of two-three meters. **Young shoots** yellowish green, slender, peg-like pointed at the apex, sheaths covered with dark brown and yellowish hairs.

Leaves 15–28 cm. by 2–4 cm. linear lanceolate, apex acuminate, margins scaberolous, rounded and usually oblique at base with a short petiole. Leaf-sheaths hairy when young, auricle falcate with few long hairs.



Inflorescence a panicle bearing spicate branches with cluster of erect spike lets.

Commonly cultivated in the villages particularly in Mayurbhanj and Baleswar districts of the state. Occasionally planted in other districts.

USES: The most preferred species for building purposes and for scaffolding. The culm is good, strong and straight, thus has a variety of uses. Also used for mat making and agarbati sticks. Large quantities are supplied to paper pulp industries and bamboo wood chip industry.

Bambusa nutans





Young Shoot



Leaf



Culm



Branching





The clump

Culm-Sheath

Ligule







Wavy & unequal
Auricles

TALEDA BAUNS

***Bambusa tulda* Roxb.**

Dendrocalamus tulda (Roxb.)

A slender tufted bamboo forming dense clumps. **Culms** sleek, tall, often attending up to 15 m. height and 4–6 cm. in diameter; smooth, white-scurfy when young, grayish-green on maturity, with characteristic **white rings** at the node, nodes slightly thickened. Internodes 35–45 cm. long, with small lumen and 2–2.4 cm. thick walls. Lower internodes are at times fully solid. Branches emerging from lower nodes are few, slender, horizontal and almost leafless. Upper branches bear profuse leaves.



Culms-sheaths 15–22 cm. long by 12–25 cm. broad, glabrous, green, white-powdered, generally narrowed up wards with mouth sub-truncate rounded or sub triangular; blades open, erect, cordate, cuspidate or broadly lanceolate with the apex sharply constricted into an elongated pointed tip. Ligule is continuous with the sheath top. Auricles prominent, ciliate, unequal; larger one wavy and continuous with the blade, the other is oval or rounded and erect. Leaves linear-oblong or lanceolate, 15–25 cm. by 2–3.5cm, base usually rounded, tip subulate twisted, petioles often hairy; leaf-sheath glabrous ending in a smooth callus and oblong fringed auricle.

Young shoots whitish-green with yellowish tinge on the sheath margin; sheath-blades open and leaf-like, auricles brown.

This species is cultivated in different parts of the state but not widespread.

USES: Favoured for basketry and woven applications. Used for roof structure in thatched houses and in cultivation of betel vine. Being a thick bamboo, it is suitable for mechanized processing for bamboo boards and composites. Young shoots are used for making excellent pickles.



Bambusa tulda



Leaf



Young Shoot



Culm





Culm-Sheath



Rounded
&
Elongated
Auricles



DANGI

***Schizostachyum pergracile* Munro.**
Cephalostachyum pergracile Munro.

A moderate-sized elegant bamboo found occasionally in shady valleys and *nala* banks deep inside the forests. **Culms** 7–9 m tall, straight, slender, ashy green and covered with whitish-powder when young; nodes hardly thickened, internodes 35–50 cm long, 4–6 cm diameter with very thin walls; wall thickness decreasing towards the top.



Culm-sheaths short, covering less than half of the internode, light brown, covered with patches of shining black, stiff deciduous hairs when young, afterwards much polished and chestnut brown. Sheath blade triangular, deflected, hairy within; ligules narrow and entire, auricles prominent, rounded, and having long white curved bristles on their edges. Branches beautifully fascicled at the nodes, thicker and upper branches spreading horizontally, lower thinner ones drooping downwards. Leaves 15–30 cm long, 2.5–4 cm broad, linear-lanceolate, base rounded or cuniate, midrib conspicuous, sparsely hairy on either surfaces or sub-glaucous beneath, margins scabrous. Leaf-sheath glabrous except on margins of the small auricles.

This species grows on the lower slopes along with *D. strictus*, which occupy the higher slopes. Sporadic clumps are found in Dango-West reserve forest of Phulbani Forest Division.

USES: The green culms split and crack on drying. Being soft on nodes, it is extremely popular with artisans for making fine works such as hats, flower baskets, decorative mats etc. The hollow internodes are very much sought after by rural women to be used as blow pipes for fanning the fire in the hearth.





Schizostachyum pergracile



Branching







Culm


Young Culm


Leaf


Culm-Sheath

PANIBANS or BOLANGI

***Gigantochloa rostrata* Wong.**
Gigantochloa maxima var. *minor* Holttum
Oxytenanthera nigrociliata Munro.

A small bamboo forming dense clumps from a stout and stoloniferous root-stock and mostly occurring on the alluvial banks of the streams. **Culms** 4–7 m. long, 2–5 cm diameter, dark green in colour, slightly drooping outwards. In young culms the basal internodes are striped with yellow lines. The lower nodes bear rootlets up to 6–7 basal nodes. Internodes 30–35 cm long, thick walled and have **dull white bands** on both sides of the nodes in younger culms. The lower half of the bamboo is solid and has a narrow lumen towards the top.



Culm-sheath 10–15 cm long, slightly narrowed to wards tip, deciduous, with dark brown hairs, ligule short, irregularly dented; auricles small, oval, erect, with long bristles on the margin. Sheath blade ovate-lanceolate, up to 6 cm long, deflexed.

Leavers 15–25 cm by 2–3 cm., lanceolate, tip subulate often twisted, base unequal and rounded then suddenly narrowed to the short petiole, young leaves pubescent beneath, margins scabro-ciliate towards base; leaf-sheath stiff, margins ciliate, auricles forming an inconspicuous rim.

Young shoots dark green, sheath covered with glossy black hairs, auricles having long bristles, blades erect imbricating, shoot apex pointed.

This species is found in moist valleys along stream banks in Mals of Khurda and Kandhamal districts.

USES: The culms are used for hutments, basket making and specially for stitching of leaf-plates. It is said that the tribal women while visiting their friends and relatives in other villages, where this bamboo species is not available, carry stitching sticks prepared from this bamboo as a gift.





Gigantochloa rostrata



The clump by the side of a stream



G.rostrata
growing on the trunk of
Ficus benghalensis



Young Shoot





Leaf







Culm





Culm-Sheath

NALA BAUNS

Thyrsostachys oliveri Gamble

A straight growing, moderate-sized, handsome bamboo with **persistent culm-sheath** and branches arising from the middle of the culm. Absence of branches on the lower portion and persistent culm-sheath makes a unique feature to locate this species from a distance.



Culms smooth, 8–10m high, 4–5 cm diameter, bright green with whitish silky surface when young, dull green or yellowish on maturity, nodes hardly swollen, internodes 30–40 cm long, walls thin, 0.5–0.8 cm thick. The **culm-sheath** fibrous, long, covering almost the entire internode and often extending to the next internode, imbricating at the base, green when young, turning grayish-brown latter, clothed on the back with thick white pubescence, margins thin, narrowed down gradually towards the top; ligule continuous and dentate; auricles short, blade triangular, up to 15 cm long, 2–3 cm broad, recurved and deciduous. Branches fascicled at the nodes, lower ones ascending and upper branches horizontal. Leaves lanceolate, acuminate, 15–20 cm long, 1.2–1.5 cm broad, base rounded in to a short petiole, both surfaces rough, hairy beneath, scabrous on the margin.

Young-shoots cone-shaped, green mixed with brown and orange coloured patches, covered with white hairs, blade narrow, erect.

This species, **a native of Burma,** is now found in the village grooves of Nayagarh and Ganjam districts. The straight and loosely packed clumps can be seen between Odgaon and Bhanjanagar in the roadside villages. The local people say that their elders had brought this bamboo from Burma and introduced in their area.

USES: A good bamboo for basket and mat making and also for thatching the roof. Can be used for reinforcement for concrete slabs and handicrafts. Young shoots are commonly used in Thailand for edible purposes. This species and T. regia are the main source for production of steamed bamboo shoots in canning industries of Thailand for export to Japan.



The clump



Culm







Young shoots



Branching



Leaf









Culm-Sheath

LATHI BAUNS

Thyrsostachys regia (Munro.) Bennet.
Thyrsostachys siamensis Gamble

A small but graceful bamboo with compact and out-curving stems. **Culms** 5–7 m long, 2–4 cm in diameter, arching towards top, thick-walled with a very small lumen; base usually covered with the persistent culm sheaths; nodes hardly thickened, with a white band below; internodes 25–30 cm long, light green.



Culm-sheaths 20–25 cm long, 10–15 cm broad, covered with fine white pubescence on the back, margin ciliate, attenuate into a 3.5–4 cm broad truncate top; ligule prominent, narrow, slightly toothed; auricles small; blade 10–12 cm long, triangular, erect when young but subsequently deflected, edges incurved. Sheaths continue to remain attached to internodes for a pretty long time even up to second year. Leaves 8–15 cm by 0.8–1.2 cm, narrow, linear, short-stalked.

Young shoots initially greenish-brown turning green latter, blade tapering at the base, linear-lanceolate, sheath long with brown hairy margin.

Introduced in Orissa by the Silviculture Division successfully and planted in Khandagiri Research Garden.



USES: In its native country, Thailand, this is one of the important bamboos being used for basketing, handicrafts, umbrella handles, furniture etc. Tender shoots are considered as delicacies. In Burma, it is mainly planted in gardens as an ornamental bamboo and also used for umbrella handles.

T. regia

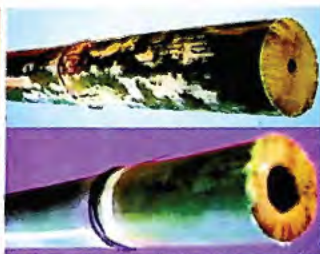


The clump



New & old Sheath





Culm



Branching





Culm Sheath





Leaf



Young Shoot

Dendrocalamus giganteous **Munro.**
Bambusa gigantea Wall.

A very tall bamboo with close culms and slender branches. **Culms** 20–25 m. tall, 15–25 cm diameter, usually 1.5–2 cm thick-walled, dull green, covered with white waxy powder when young; internodes 35–40 cm long, lower nodes with root scars.



Culm-sheaths 30–50 cm long and broad, hard, smooth, dull yellow and covered with brown hairs on the back; ligule small, stiff; auricles distinct, brown, crisped; blade 12–35 cm long, spreading at right angles, acuminate, edges inflexed. Leaves variable in size, in main culm up to 50 cm long and 10 cm broad, oblique, oblong, acuminate, petiole l3–15 mm long, auricle small, glabrous.



Young shoots cone-shaped, initially violet-brown, glaucous green with age; auricles very small; blades leaf-like, sharply pointed, generally reflexed.

This species was introduced by the Silviculture Division of Forest Department and was planted in Kalinga Research garden. Planting in other areas of the state was tried but not promising.

USES: In North-eastern states this bamboo is used for building purposes, mast of boats, flower vases, various other decorative purposes and also as water pitcher.

D. giganteous



The Clump



Culm



Leaf



Young Shoots





Culm-Sheath

CHAMPA BAUNS

***Bambusa striata* Lodd. ex Lindl.**
Bambusa vulgaris var. *striata* (Lodd. ex Lindl.)

A graceful, tufted bamboo. **Culms** 8–10 m high, 4–7 cm in diameter, **smooth yellow** with light green stripes or at times light green with yellow stripes; internodes 15–25 cm long, thick-walled. **Culm-sheaths** similar to *B. vulgaris* but more yellowish and little smaller. Leaves 12–20 by 2–2.5 cm, linear- oblong, lanceolate, base obtuse and oblique; petiole short; leaf-sheath smooth, truncate, ciliate.

Young shoots yellowish-brown, streaked; sheath with dark-brown appressed hairs, auricles distinctly falcate, blades yellowish-green to green.

Introduced in Orissa by the Silviculture Division successfully and planted in Khandagiri, Joshipur Research Gardens.



USES:

It is mainly used for ornamental plantings; can be used for construction purposes.



Leaf





Culm

Young Shoot





Culm-Sheath

***Bambusa wamin* Camus.**
Bambusa vulgaris var. *wamin* McClure

This is a medium to small sized bamboo. **Culms** 3–6 m long, loosely tufted, dark green, glabrous, arching outwards; internodes 10–15 cm long, **swollen like a pitcher** up to certain height of the culm; lower nodes bear rootlets. **Culm-sheaths** up to 12 cm long, covered with brown hairs, resémbling that of *B. vulgaris;* seath-blade 5 cm, yellowish, triangular with two rounded ciliate auricles at the base. At times culms having normal internodes also develop from the clump. Leaves 15–25 cm long and 1.5–3 cm broad.

Young shoots are green at the time of emerging from the rhizome but subsequently turning to yellowish green.

Introduced in Orissa by the Silviculture Division successfully and planted in Khandagiri Research Garden.

USES: It is mainly planted in gardens as an auspicious and ornamental bamboo.





Culm





Young Shoots

DISEASE & PESTS

Diseases

Bamboo suffers from diseases caused mainly by fungi, which attack the rhizome, roots, culms, foliage, flower & seeds. A large number of saprophytic and parasitic fungi attack the bamboo culms. Felled bamboos are damaged mostly by saprophytic, sap staining and soft-rot fungi. Exposed roots are more susceptible to disease attack.

The most important disease, causing epidemic, is the **bamboo blight**. This disease has affected *Bambusa*



vulgaris in coastal Orissa during 1985–88 causing large-scale death of full-grown clumps in village groves. It has spread to Orissa from Bangladesh via West Bengal. The blight affects the young culms during or soon after the elongation process starts. The symptoms of the disease are premature death of the culm sheath, which can be easily removed, unlike the healthy ones, and partial collapse of the apical region with wet-rot patches developing on the internodes. After rotting of the internodes, a variety of insect larvae, beetles, ants and termites get associated and aggravate the damage. The dead areas spread rapidly in the tender culm and the apical region dies, ultimately killing the entire clump over a period of 3–4 years.

The casual agent of bamboo blight is a fungus known as *Sarocladium oryzae*; which is also a pathogen of rice. This disease can be controlled by improved cultural practices and drenching of soil by fungicides. The blighted bamboos are to be cut and removed. Light burning around the clump and provision of earth mounding to the base of the clump, before the monsoon, can improve the clump condition. Treatment of soil (drenching of bamboo clumps) with copper oxychloride and Dithane M 45 has given good results in controlling the bamboo blight.

Insect Pests

In India, the pest attack epidemic in standing bamboo crop is not quite frequent nor has raised any serious concern. However Bamboos are prone to attack by various groups of in-



sects during their growth. Occasionally there is attack by (1) defoliators, (2) leaf rollers, (3) sap-suckers and (4) shoot and culm borers. The shoot and culm borers cause more damage to bamboo clumps as compared to other groups of insects. Ghoon & other borers attack the cut and dry bamboos most frequently.

Defoliators

A group of insects belonging to Orders Lepidoptera and Orthoptera cause damage to leaves. Defoliators & leaf rollers cause the major damage during rainy season leading to foliage loss. It is not easy to use insecticides during the rains for controlling the pests. In case of epidemics aerial spraying can be resorted to in the infested area.

Shoot & Culm Borers

The shoot and culm bores, belonging to Orders *Coleoptera*, *Lepidoptera* and *Diptera*, mostly damage the tender culm shoots. During the rainy season, when young shoots sprout, the weevils and beetles become more active and make holes in the tender culms to obtain the sap. They lay eggs below the culm–sheath and the larvae coming out from the eggs, make tunnels through several internodes perforating each node and ending in a hollowed and dead terminal shoot. The larvae completely eat out the soft tissues of the young shoots leaving only the culm sheaths. Due to damage of the terminal buds, the juvenile culms may die completely or the basal portion may develop multiple branches of little commercial value.



When older the larvae bore holes in to the soft stem under the shelter of the culm sheath. In such cases some internodes are perforated but the young shoot continue to grow. But latter on the culm may break from the perforated internode before maturity.





The attack is more in congested clumps as compared to well-thinned and worked crops. The normal cultural operations prescribed for working of bamboo such as removal of damaged shoots, thinning of clump to reduce density and exposure of culms to sunlight can control the pest attack to a great extent.

Pests of felled Bamboos

Borers are the most important pests of felled and dried bamboos. The three species responsible for causing major damage to bamboo during storage and use are: *Dinoderus brevis*, *D. minutus* and *D.ocellaris*. They are collectively known as *ghoon borers* or shot hole borers. They cause immense damage when the bamboos are in the process of drying. Presence of starch, soluble carbohydrates and proteins in the bamboo increases its susceptibility to borer attack. These ghoon borers have 3–4 generations in a year. The most active period of borer attack is March onwards. The beetles bore into the cut bamboo through spots where external rind has been damaged. They also bore into the exposed transverse sections of the cut ends and into internal walls of the bamboos. They construct tunnels either vertically or horizontally and reduce the bamboo to dust. The ghoon borers also attack the bamboos even after it has been made in to furniture and mats etc. For protection against ghoon borers both prophylactic methods and preservative treatments are important.

The prophylactic methods are:

- Bamboos should be felled when the starch content is at its lowest level i.e. between October to February.
- Matured bamboos at least 3 years old should be used after proper seasoning and preservative treatment.
- Seasoning is mandatory to achieve the strength and durability. Bamboo should be seasoned to about 12% moisture content. 3–4 year old bamboo is good for seasoning.
- Leaching out of starch, sugar, and other water soluble materials from the freshly cut bamboo by sub-merging in water for a period of 10–20 days reduces the borer attack. Running water is considered better than stagnant water.

Protective treatment

To increase the life of lingo-cellulosic materials, effective preservative treatment is essential. Like some of the timbers, bamboos when properly treated with suitable preservative become resistant to the attack of insects and fungi. The service life is enhanced depending upon the proportion of penetration of the preservative. Various methods like diffusion, soaking, steeping, and sap displacement etc. has been prescribed. Techniques for application of preservatives include brushing, spraying, dipping, hot and cold bath treatment, pressure treatment etc.



METHOD OF PROPAGATION

Different methods of propagation are followed to obtain planting materials for multiplication of bamboo. The easiest method is to **raise seedlings from the seeds**. Seeds can be procured from the area where sporadic or gregarious flowering has occurred. The bamboo seeds have no dormancy but the viability period is limited. To obtain higher percentage of germination, fresh seeds should be sown immediately after collection. After sowing the seeds in the mother beds, light straw cover is to be provided for 2–3 days to enhance the germination. Prophylactic treatment may be required to guard against termite/fungal attack. Germination starts between 4–10 days after sowing. After a month these seedlings can be transplanted to poly pots of 24cm x 18 cm filled with soil mixture and be maintained for a year before planting.

Since the seeds of many bamboo species are not available regularly, various methods of **vegetative propagation** have been developed/practiced. The methods generally used are:

- **Macro-proliferation:** In the early stage of growth of the seedlings the young sprouts along with a portion of rhizome are separated from mother plant and grown in other poly pots. 3–4 sprouts can be obtained from each seedling over a period of 6 month. The detail method has been described separately.
- **Offset planting:** The rhizomes of one to two-year-old culms are utilized for planting. The bamboo is cut 2–2.5 meter above the ground and the rhizome is dug out. The villagers invariably adopt this method for growing new clumps. The offsets are to be planted within 2 days after removing from the mother clump to avoid drying of rhizome.
- **Layering:** Whole bamboo layering method has been adopted to develop rooting and sprouting at each node. The young culms are bent down to ground level and buried under the soil over the entire length. Regular watering is required to keep the soil moist. After the sprouts growing from the nodes develop basal rhizome, the internodes can be separated and planted.
- **Culm cutting layering:** Bi-nodal and multi-nodal culm cuttings have been used to produce planting materials in large scale. The age of the culm and the period when these cuttings are layered for rooting are important factors. Second year

old culm and layering in the month of March-April have been found to give best results. The standard method is described separately.

- **Branch cuttings:** The bamboo branches can be used to produce propagules under regulated environmental conditions.
- **Tissue culture:** Protocols have been developed by various research institutes to produce planting materials by tissue culture for some bamboo species. But successful field trials are very limited till date.

In Orissa except for Salia bamboo (D.strictus), which is propagated by raising seedlings from the seeds, multiplication is through offset planting only. This method, though practiced by the villagers from ages, has limited application for undertaking extensive plantation because of the limited availability of the planting material. However, the vegetative propagation methods such as macro-proliferation and rooted-culm-cuttings can be successful with most of the commercially important bamboo species for raising large-scale plantations.



The Technique of Seedling Multiplication (Macro-proliferation)

Young **bamboo seedlings produce a large number of tillers** till the rhizome is fully grown to produce usable culms. This characteristic has been utilized to produce a number of propagules from one viable seed at least for few years. Since the seeds of bamboo are not available every year, this method of propagation can be depended upon to raise regular plantations. Seedling multiplication through the technique of macro proliferation can ensure continuous supply of large number of planting material for a couple of years.



Young seedlings can be raised in the mother bed from the seeds or can be picked up from the forest floor for transplanting in the polypots. Prior to this, soil mixture is prepared by adding good pulverized soil, fully decomposed dried and powdered farmyard manure and sand in 1:1:1 proportion. This soil mixture is filled in the poly pots of size 24cm x 18 cm. A basal dose of fertilizers i.e. Urea (N46.4%)-0.05 gm. Super phosphate (P_2O_5 – 16%) – 0.6 gm. and Murate of potash (K_2O56%)-0.04 gm is added to each poly pot. The fertilizer dose is mixed with 30 ml of water and applied to soil mixture before transplanting the seedlings. Transplanting will be done in July by planting one good seedling in each polypot. Immediately after transplanting, the seedlings are to be kept under shed for 4-5 days and thereafter can be shifted to open area under direct sunlight. Watering and weeding are carried as and when required. After a month second dose of fertilizer i.e. Urea – 0.12 gm and Murate of potash – 0.12 gm is to be applied to each polypot.

The seedlings will produce 4-6 tillers over a period of 6 months.



At this stage the proliferated **seedling is removed from the polypot** and **tillers are separated** along with their rhizome and root carefully.





Tillers are to be separated very carefully keeping the rhizome and roots in tact.

Each tiller is planted in a fresh polypot of 24 cm x 18 cm size containing soil mixture for further proliferation.





The process can be repeated to produce more and more propagules.

However those stems, which become thicker will be separated and be utilized for field planting.



Seedling Production by Layering of Culm-Cuttings



Young (2 year old) and healthy culms from selected clumps are extracted by cutting just above the second node. The leaves & side branches are trimmed off and the bamboo is cut in to a number of bi-nodal (one inter node with two nodes) pieces.

Care is taken to avoid splitting of the cut ends while preparing the bi-nodal pieces.

A hole is made on the inter node to fill water in the lumen. While making the hole, care is taken to ensure that the lateral branches are parallel to the ground & the hole is perpendicular to the branching joint.





After filling water in the lumen, the hole is closed by wrapping with cello-tape to prevent leakage.

These water-filled cuttings are layered in the sunken nursery beds of 6mt. long and 0.75mt wide and covered with 4–5 cm deep soil.



One week prior to layering, the nursery beds are prepared by tilling the land, applying farmyard manure and drenching the soil with the insecticide (Aldrin) & the fungicide (Bavistin) to prevent termite & fungal attack. The bi-nodal cuttings are laid in the soil beds parallel to each other at 30 cm. apart keeping the hole up towards surface. Watering has to be done regularly to keep the soil moist.

Within a week the buds and roots sprout from the nodal meristem. Usually three to five tillers come up from each node.



Development of roots at the node is just not enough to ensure survival after planting. The tillers must have strong rhizome formation before planting in the field. At least six months are required to ensure development of rhizomes for each tiller that comes up from the node.





After 6 months, these bi-nodal pieces can be removed from the bed and planted directly in the field even after splitting to uni-nodal pieces.

However for further multiplication, the tillers at each node can be separated by a sharp secature to prepare propagules. Each propagule possessing a good rhizome is transplanted in polypot filled with soil mixture.





Application of fertilizer as prescribed for macro-proliferation will enhance the growth of the seedlings. Melanthion 0.2% is lightly sprayed as prophylactic treatment at an interval of two months to protect against insect attack.

After 6 month, these seedlings attain a height of 1.5 to 2.0 meters and are ready for planting.





First year growth of bamboo planted by preparing seedlings from culm-cuttings

It has been observed that two-year-old culms are best for the purpose and spring season is the appropriate time for layering of culm cuttings. Since this method does not involve any critical technique, it can be easily practiced by the farmers to get at least 50–75 plantable seedlings from each bamboo culm.

Bamboo Management in Forests



Bamboo occurs in large tracts of forests of Orissa except for the districts of Mayurbhanj, Keonjhar and Nawarangpur. It occupies about 13,950 Sq.Kms.of forests as an associate of sal, teak and miscellaneous crop. In general *D.strictus* occurs on the hill slopes where as *Bambusa bambos* occupies the moist area and nala banks. For ages together forest bamboo in Orissa was managed and exploited to meet the raw material requirements of the paper mills. Long-term leases were granted to the paper mills till I[st] October 1988, when the forest bamboo was nationalized to be harvested and marketed by the state and its Agency. Even after that, 98 percent of bamboo, extracted from the state forests, were supplied to paper mills. Due to sole dependency on the paper mills, the state has to face a marketing problem in 2001. One of the major consumers, the Orient Paper Mills was closed down and for other paper mills, the sale price fixed by the Govt. was uneconomic. Such a situation virtually stopped the exploitation of bamboo for three years, as the agency was not tuned to market the bamboo otherwise. The delay in revision of management plans (Forest Working Plans) for a number of Forest Divisions also added to the problem of harvesting bamboo from forests.



The basic principles of bamboo management centers round the growth behaviors of the culm. New bamboo culms are produced every year from the buds of the rhizome of previous year culm. The rhizomes of more than two-year-old culms, therefore, have very little role to play in production of new culms. However, bamboo culms require about three years to be fully matured after which those are to be harvested.





A congested clump of *D. strictus* (Salia)

Retention of old culms will result in congestion of the clump. After 4–5 years the old culms will dry up, split and invite pests and disease, which will ultimately affect the younger culms. Congestion of clumps is one of the most serious problems in management of bamboo forests. Therefore, in India, for most of the bamboo forests, the prescribed cutting cycle is kept at 3 or 4 years.

However, the **rural artisans are habituated in using 1–2 year old culms** for ease of preparing slivers. This has resulted in damage of clumps due to poor growth of rhizomes after removal of the young culms. The 3–4 year old culms, harvested from forest by the department, are not suitable for their purpose due to its hardness. A via media has to be developed.



The **artisans are to be trained**/facilitated to use two-year-old culms and the management principle has to accommodate for harvesting of these culms to stop the menace of illegal cutting of young culms.



Bamboo in Orissa is managed under ***"Culm Selection-cum-Clump Improvement" Silvicultural System.*** A revised prescription for forest bamboo working in Orissa was approved in 1990 by the Chief Conservator of Forests, Eastern Regional Office, Ministry of Environment and Forests, Government of India, Bhubaneswar vides their letter no.13/FCWP/US-Gen.dated 24.12.1990 and communicated by the Principal Chief Conservator of Forests, Orissa vide Memo no.26951(40) dated 28.12.1990.The commercial exploitation of bamboo from forests within the Wildlife Sanctuaries has been stopped by the State Government from 1997. The approved management prescriptions are appended as Appendix-A.

In order to improve the growth and productivity of bamboo crop, regular cultural operations are to be carried out. The management principles recommend the following silvicultural operations in bamboo forests immediately after harvesting of bamboo at an interval of four years.

- Removal of all dead, dried, burnt and malformed culms from the clump.
- Soil mounding up to first internode in and around the periphery of the clump by cutting soil from up-hill side in half-moon shaped trench. The half-moon trench helps in moisture conservation.
- Stone packing on down hill slope encircling the mound to act as a protective barrier against erosion.
- Climber cutting.
- Fire protection measures.

Current Policy on Bamboo

Bamboo working in Orissa has been nationalized since 01.10.1988. The state Govt. have appointed the Orissa Forest Development Corporation Ltd. as the sole Agent for extraction and trade in bamboo all over the state.The O.F.D.C. Ltd. extracts bamboo from forests in form of indrustrial bamboo bundles for the paper mills and long bamboos (Commercial bamboo) for house-hold uses.The paper mills of Orissa are the main users of bamboo extrcted from forests. Only about five percent of the total harvest is extracted as long bamboos for household and artisan activities.

The measurement unit for indrustrial bamboo has been the 'Sale Unit' (SU), notionally equivalent to one MT in weight. Salia bamboo of 2400 m running length constitute one Sale Unit. Salia bamboos are cut in to pieces of 2.3m length having not less than 4cm girth at thin end and made in to bundles of 21 pieces each to form a 'full bundle'. Smaller pieces of more than 75cm long are also made in to bundles of 21 pieces each to form a 'half bundle'. Thus, 49.689 full bundles of Salia constitute one Sale Unit of industrial bamboo. In case of Daba bamboo (Bambusa bambos) a full bundle contains 7 pieces of 2.3m long each.149.07 full bundles of Daba bamboo make one Sale Unit. However, for the purpose of sale price one Sale Unit of Daba bamboo is treated as equivalent to 2.5 Sale Unit of Salia bamboo. Notionally, 350 numbers of long (Commercial) Salia bamboo is taken as one Sale Unit.

The state Govt. have constituted one high power committee designated as the "Empowered Committee" under the chairmanship of the Chief Secretary, Orissa to decide the mode of disposal of both industrial and commercial bamboo harvested from forest. The Empowered Committee annually decides the target of production, allotment of industrial bamboo to different paper mills of the state, expenditure norm, royalty to be paid to Govt. and also the sale price for both industrial and commercial bamboo.

Recorded Bamboo harvest from Forests during last two decades

Year	Yield in lakh \MT	Royalty received by the state (Rs. in Million)
1980–81	3.48	23.55
1981–82	3.02	26.53
1982–83	2.95	21.59
1983–84	2.63	24.32
1984–85	3.88	30.88
1985–86	2.89	30.90
1986–87	2.15	29.97
1987–88	2.54	30.00
1988–89	2.61	75.93
1989–90	2.39	78.95
1990–91	2.20	74.55
1991–92	2.38	82.56
1992–93	2.45	87.31
1993–94	2.41	101.14
1994–95	2.40	103.50
1995–96	2.18	95.31
1996–97	2.46	90.00
1997–98	2.08	85.00
1998–99	1.20	85.00
1999–2000	1.12	20.00

The above production figures only indicate the bamboo extracted from forests by the lessees (up to1987–88) and the Orissa Forest Development Corporation Ltd. Apart from the recorded harvest, substantial quantity of bamboo is also felled and removed from forests by local people and artisans for house hold use and occupational livelihood. However, no estimation has been made to assess the total annual harvest of bamboo from forests.

The Future Prospective

Bamboo is one of the most abundant and renewable resources available in Orissa covering nearly 30% of the total forest area of the state. Presently the use of bamboo from forests for its major industrial use i.e. paper manufacturing, is decreasing. The lack of demand for bamboo by paper mills has resulted in non-disposal of harvested bamboo by the Orissa Forest Development Corporation Ltd. This has adversely affected the livelihood opportunities of rural communities and forest fringe dwellers, who were previously engaged in extraction of forest bamboo. However bamboo has the potential for generation of gainful employment through various bamboo-based industries which can be developed on the technological advancements made in India and other countries.It offers tremendous employment and income-generation opportunities to the community for the invaluable role they can play covering harvesting and regenaration, treatment and other value addition options linked to various industrial products. Considering the situation, the state had engaged IPIRTI, a Research and Training Institute of the Ministry of Environment & Forests, Government of India to prepare a comprehensive action plan for alternate industrial uses of bamboo produced in the state. Preliminary findings of the study suggest that Orissa bamboo is suitable for mat based products and the people possess adequate basic skills for weaving mats that can be upgraded through hands-on training. In collaboration with **INBAR and IPIRTI, the Orissa Forest Department has organized a two-day state level workshop at Bhubaneswar on 28-29 January 2004,** with a view to initiate the process of sensitizing various stakeholders.



Sj. Naveen Patnaik
Hon'ble Chief Minister, Orissa
inaugurating the workshop

The consensus outcome of the workshop was for establishment of an apex body in the state to harness the potential of bamboo sector for poverty alleviation in the state. Accordingly, a proposal for constituting "Bamboo Development Mission" is under active consideration of the state government.



WORKSHOP IN PROGRESS

(L-R) **Sri P. R. Mohanty,** IFS, *Principal Chief Conservator of Forests, Orissa,*
Sri Naveen Patnaik, *Hon'ble Chief Minister, Orissa,*
Sri G. B. Mukherji, IAS, *Principal Secy. to Govt. of Orissa, Forest & Env. Dept.*

Government of Orissa intends to constitute the **Orissa Bamboo Sector Development Mission** for strategic planning and implementation of schemes and programmes for sustainable management of bamboo resources in the State and to develop bamboo based livelihood system and manufacturing value added bamboo products with the following objectives:

- Generation of additional employment opportunities for the rural communities in general and forest fringe dwellers in particular.
- Creation of more livelihood opportunities for bamboo artisans and workers by linking them with industries and exporters.
- Generation of awareness about latest processing techniques for using bamboo in various sectors including housing and construction, tourism, food and fodder etc.
- Creation of enabling environment for establishment and growth of bamboo-based industries including export-oriented handicrafts, and to facilitate development of small/medium scale enterprises.
- Building and strengthening of institutions at village cluster, district and state levels through suitable linkages for the promotion of bamboo based economic activities.
- Creation of environment for the sustainable production of bamboo from the bamboo bearing forests in the State
- Promoting production of quality bamboo required for various end uses both for industries and handicraft sector through plantation of suitable species in private areas and also their introduction in selected forest areas.

Enhancement of Productivity

In the descending order of commercial importance, bamboo species available in Orissa can be listed as: 1.*B.bambos*, 2.*B.nutans*, 3.*B.vulgaris*, 4.*B.tulda*, and 5.*D.stictus*. But the last one i.e. *D.strictus* (Salia bamboo) accounts for almost 90% of bamboo resource of the state. This resource is also depleting very fast in certain regions of the state due to increasing demand and consequent over cutting. The demand is met by cutting young bamboos particularly one-year-old culms. Removal of young culms hampers the growth of current year rhizome, which cause the progressive degradation of the clump. The number and size of new culm is reduced year after year and ultimately the clump is reduced to a bush producing only finger thick shoots. Large chunks of bamboo forests of the state have been degraded to such unproductive crop. This situation calls for an immediate inventory of the resource and management intervention to improve the stock. The Salia bamboo (*D.strictus*), which forms the major portion of the bamboo resource, has many variants. In some regions of the state the quality of the crop is very low; the culms are thin, short length and at times hollow. Study is required to ascertain whether this low quality is due to genetical variation or due to bio-edaphic factors. Variation in growth & productivity is also observed in *B.vulgaris*, the species cultivated by the villagers. Selection of superior clones and their propagation will certainly improve the resource. This will involve both *in-situ* and *ex-situ* conservation of germplasm, their evaluation and multiplication.



The areas containing quality bamboo crop have to be identified for *in-situ* conservation and seed production.

However, such Seed Production Areas can be identified for the salia bamboo only. Since this species grows gregariously in Govt. forests and produce seeds periodically by sporadic flowering. In case of other species, superior clones are not found in compact patches. Most of these clumps are occurring in private lands, in scattered locations and hence *in-situ* conservation is not possible. These superior clones are to be identified, collected and vegetatively propagated to create large number of Bamboo Multiplication Gardens.

The important morphological characters to be considered for selection of superior genotypes of a species are:

- Age group-wise number of culms in the clump
- Height of individual culm
- Girth of the culm
- Length of internode
- Wall thickness and
- General health of the clump

Initially large numbers of **'Candidate Plus Bamboo Clumps'** (CPBC) are to be selected by conducting inventory through out the state. The growth parameters are to be recorded annually for a period of at least 3 years. After analyzing the growth records final selection of superior bamboo clones (Plus Clumps) of a particular species will be made. The finally selected ones are to be assigned a clone number to facilitate future reference.



To conserve the genotype and to ascertain the hybrid vigour of these clones, Germ Plasm Banks are to be established. Progeny trials are to be conducted in different agro climatic zones of the state by producing propagules through vegetative propagation methods. Field trials are to be conducted to test the variation in growth and productivity.



Cultivation models including inter-cropping methods are to be standardised for different bamboo species for different regions of the state. The degraded bamboo forest areas are to be rejuvenated by improved cultural practices. In some areas it can be replaced by planting high yielding superior genotypes (clones) of commercially more important species to enhance the productivity.

The following activities need immediate consideration for improvement of the resource base:

- Rehabilitation of degraded bamboo areas
- Introduction of new bamboo species
- Study the culm production in different intensity of felling cycle to prescribe cutting period to meet the requirement of artisans
- Study the growth and production behaviour in different climatic and edaphic conditions
- Development of technique for vegetative methods of propagation for mass production of quality planting material

Bamboo as Commercial Crop

Bamboo holds the potential to be a vehicle for economic growth for the people of Orissa.In terms of uses, it is already playing a leading role adressing the needs of rural housing, basketery, handicrafts and other utility items with more options likeky to emerge in future.The cultivation of bamboo needs to be encouraged. The National Bank for Agriculture and Rural Development (NABARD), is promoting a number of projects for bamboo cultivation / plantation in different states under its Forestry / Agroforestry progammes.The Orissa Regional Office of NABARD has approved schemes for cultivation of pure bamboo crop of Bambusa vulgaris, Bambusa nutans and Dendrocalamus strictus.Besides, farm forestry projects for cultivation of Bamboo with Teak and Bamboo with Eucalyptus are also financed by NABARD. The detail unit cost (subject to modification by NABARD from time to time) for each of these projects is given in Appendix-C.



APPENDICES

Appendix-A

PRESCRIPTIONS FOR BAMBOO WORKING IN THE WORKING PLANS OF ORISSA FOREST DEPARTMENT

The following cutting Rule of Salia and Daba Bamboo have been prescribed for systematic working of Bamboos in all the Divisions of the State of Orissa.

Silvicultural System:

The Sylvicultural System prescribed is **"culm Selection-cum-Clump-Improvement"** combined with simultaneous cleaning and cultural operation for **Saila** Bamboos.

&

"Clump Improvement" combined with simultaneous cleaning and cultural operation for **Daba Bamboos.**

Felling Cycles:

A felling Cycle of 4 years is adopted both for Saila as well as Daba Bamboos.

Regulation of the Yield:

Yield will be regulated entirely by area and the coupes in each felling series are to be worked out by rotation.

Agency of Working:

As Bamboo has been nationalized, the State Government shall decide the Agency of working.

Estimation of the yield for fixation of Target:

Basing on the clump quality, treatment types as well as enumeration by-stratified sampling the estimated yield (target) shall be arrived at by the Agency for working. This work should start by June-July and completed by August for the coupe due for working so that new Karadies (Karlas) are taken into account.

Sequence of Felling:

A definite sequence of felling in Bamboo Coupe is essential. The Coupe should be divided into four Sections running along the contours. The Sections from the uphill side should be worked first and the first section should be completed in all respects before the work commences in the second Section and so on.

Demarcation:

The Bamboo Coupe should be demarcated by giving double coal-tar ring at the breast height on all the trees, which are distinctly visible from each other. The Section line should be identified by giving single coal tar line. Sign-board shall be displayed on compartment lines. Road Crossing, Nulla crossing and other strategic points mentioning the details of working.

Treatment Maps:

(i) Having completed the demarcation of Bamboo Coupes and before taking it up for working, a Treatment Map will be prepared by the Agency for working on a copy of the available Management Map in 1:25,000 scale indicating Salia and Daba bamboos area separately.

(ii) Treatment types to be distinguished shall be based on the assessment of the standard Salia bamboo quality classes and actual clump condition.

In both these cases areas less than 4 ha. in extent will not be separated out as distinct Treatment Types.

(iii) Treatment Types of Salia Bamboos:

The following Treatment Types have been identified for Salia Bamboo area. Salia Bamboo forest will be categorized for different Treatment as described below:

Treatment Type-A:

Areas with healthy and well-stocked Bamboo clumps consisting of

Clump Quality-I	:	Clum height of Bamboosa: 9 m and up
Clump Quality-II	:	Clum height of Bamboos: between 6 to 9 m.
Clump Quality-III	:	Clum height of bamboos below 6 m.

Treatment Type-B:

Areas with well-stocked but degraded, damaged, congested and /or fire burnt clumps

Treatment Type-C:

Areas wherein bamboo clumps are sparse and scattered

If necessary, these Treatment Type B & C may be further classified into the above three clump quality classes.

Cutting Rules for Salia Bamboos:

Salia Bamboo (*Dendrocalamus strictus*) will be worked as per the following prescriptions.

Part – I

Rules, which are uniformly applicable to all the Treatment Types:

(i) Karadi (culm upto one year of age) and the bamboo culm over one year but under two years of age will not be cut under any circumstances. Such more than one year old culms and the clums which are older than 2 years but less than 3 years of age are to be retained in the clump and their number should not be less than number of Karadis.

The minimum number of culms to be retained in a clump is fixed on the basis of quality of the clump and it is as follows:

Clump Quality –I	20 culms	Clump Quality-II	15 culms
Clump Quality-III	10 culms		

(ii) Clumps having the minimum or less than minimum prescribed number of culms shall not be commercially exploited. Only broken, dead, dry, badly damaged and malformed bamboos will be felled.

(iii) A clump will be distinguished, as an independent clump where it's periphery is easily discernible from others. Only where such a distinction is not possible, two clumps within one-meter distance will be regarded as one.

(iv) While retaining culm against felling in a clump they should remain well spaced and preferably at the periphery and in the order of preference as follows:

(a) Karadi Bamboos

(b) Kasi bamboos (older than one year but less than 2 years)

(c) Pakala Bamboos (Young green Bamboos).

(d) Older live Bamboos.

(e) Others as may be available.

(v) Rhizomes will not be dug.

(vi) The height above which culms are cut shall not be less than 15 cm or more than 45 cm from the ground level and in no case below the first prominent node from the ground.

(vii) The cut shall be made with a sharp instrument to ensure that the stump remains in tact without splitting.

(viii) Lops and tops of bamboos will be simultaneously cleared to avoid fire hazard at least to a distance of one meter away from the periphery of the worked clumps.

(ix) Climbers shall be cut from all the Bamboo clumps during working of the coupe.

(x) Bamboo strips will not be used in tying bamboo bundles.

(xi) Bamboo felling will not be done from Ist July to 30^{th} September each year. However, all fellings and transport of Bamboos in the Sanctuaries shall be completed by the end of April positively. In case of gregarious flowering in Sanctuary areas, working period will be extended up to end of June.

(xii) If sporadic flowering of Bamboo clumps is observed, such clumps will be clear felled once the seeds from such clumps have fallen.

(xiii) In case of gregarious flowering of bamboos, on the shedding of ripe seeds, the clumps will be clear felled and extracted early so that bamboos may not dry or deteriorate or become prone to fire damage. Disposal of such bamboos should be expeditiously arranged to prevent deterioration in quality and the prescribed treatment as mentioned below shall be adopted in the gregariously flowered areas.

(xiv) Lopping of bamboos either for feeding livestock or otherwise is strictly prohibited.

(xv) As far possible, bamboo felling should be completed by the end of May (except in Sanctuaries where it should be completed by April.)

(xvi) Bamboo forests should be rigidly protected from fires and in any case forest fires should not occur during the year of working and the year following it.

(xvii) No grazing is permitted during rains in bamboo forests, which have been worked in the previous season.

Part – II

Rules applicable to specific treatment Types:

(A) Treatment Type-A:

(1) Commercial felling will be done in those clumps which have more than the prescribed minimum number of culms

(2) Cultural operations will be carried out in clumps having less than the prescribed minimum number of culms. In such clumps commercial fellings will not be done.

(B) Treatment Type-B:

(1) There will be no commercial fellings in any clump.

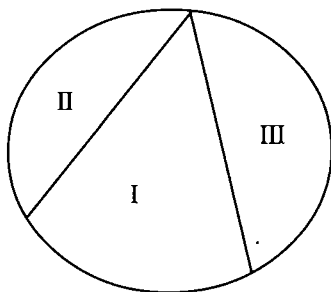
(2) Only cultural operations will be carried out which will include:

(i) Felling of all dead, dried, over-mature, burnt, broken and grossly damaged bamboos.

(ii) Broken or cut bamboos or high stumps in green condition having length of 2.5 meters or more may be retained, if necessary, to maintain size of the clumps.

(iii) The minimum number of clums to be retained per clump, as prescribed in foregoing paras for various quality classes may not be strictly followed if necessary so arises

(iv) The congested bamboo clumps should be clear felled by forming segments. The maximum number of segments, under which a congested clump should be worked, will be three and at each working not more than one segment will be cut. Where three segments are found, the middle segments will be in the shape of triangle having apex at the periphery. Only this middle segment should be felled at the first working. In subsequent cycles, side segments should be felled. Diagram showing divisions of the clump in these segments is given below:



Treatment Type-C:

(1) Only cultural operations will be carried out in the existing bamboo clumps

(2) The bamboo potentiality of such forests will be augmented by raising bamboo plantation. The minimum area to be planted annually will be 40 hectares or one third of the area under this type.

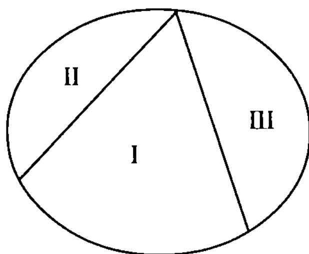
(3) Tending and cultural operations in the area planted with the bamboos will be done as per the standard practice.

Cutting Rules for Daba Bamboos (*Bambusa arundinacea*):

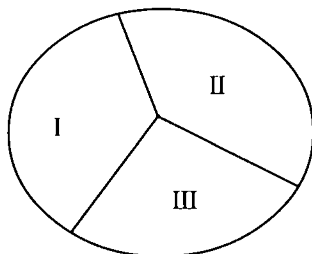
(a) All bamboo culms in a clump which are more than 3 years old shall be harvested on culm selection basis provided the number of culms left uniformly distributed in a clump shall not less than 10.

(b) In case of congested clumps where culm selection is not possible, the clump should be carefully felled by forming segments as per any of the two diagrams given below and depending on the interlacing of the bamboos with a view to provide support to the remaining segments against wind damage. The maximum number of segments under which a congested clump should be worked will be three and at each working not more than one segment will be cut. Stumps higher than 50 cm or more than two internodes should not be left un cut. Where three segments are formed, the middle segment will be in the shape of a triangle. Only the middle segment (I) should be felled at the first working. Two Diagrams showing divisions of the clump in three segments are given below:

First Preference



Second Preference



Simultaneous Silvicultural Operations:

(i) All cutting debris shall be removed from the clump and the clump shall be left cleaned. Where possible, the exposed rhizomes shall be covered with soil scrapped from the surrounding in plain areas and preferably from the uphill side of a hilly or undulating terrain. Both these operations shall have to be done along with the main cutting operation.

(ii) No damage shall be caused to rhizomes and rootstock.

Treatment of gregariously flowered areas:

(1) Bamboo seedlings at an espacement of about 4m x 4m are to be adopted and retained and the rest are to be thinned out.

(2) Cleaning, soil working and weeding is to be done around the adopted bamboo seedlings upto a radius of 50 cm.

(3) To maintain the continuity, planting up of bamboo rhizomes is also to be resorted to especially in big gaps.

(4) All the flowered clumps are to be worked up following the prescriptions of the working plan.

(5) The area should be closed for grazing.

(6) Elaborate fire protection measures are also to be taken.

In Selection forest, the age of clump varies and accordingly varies the intensity of gregarious/sporadic flowering. The delay in flowering in poor sites is due to the effect of site quality, which is related with the growth, and storage of starch, sugar and other substances in the clump, which help flowering. In a well-managed forest intensity of flowering is less in comparison to a unworked forest consisting congested clumps. Intensity of flowering is more in area having more biotic interference in form of grazing and fire in comparison to protected area. **It is important to identify the characters of flowering in Salia Bamboo to decide appropriate management technique.**

Sporadic Flowering	Gregarious Flowering
1. Scattered nature of flowering, only few clumps are involved in flowering	1. Flowering occurs almost in the entire area.
2. Only few culms flower in a clump	2. It involves almost all or some proportion of clumps. Flowering takes place in all the culms in clump.
3. The culm may or may not die after flowering.	3. All the culms of a clump die after Flowering.
4. The clump does not die.	4. Flowering is followed by the death of the clump.
5. It takes place usually irregularly almost every alternate year.	5. It follows a cycle of long interval 20 to 65 years.
	6. It progress in a definite direction like an epidemic wave.
	7. It takes 2 to 4 years to complete the flowering in the area.

The main threats to the management of bamboo forest are:

(i) Indiscriminate cutting of bamboo by tenants and artisans.

(ii) Annual forest fire.

(iii) Excessive grazing and

(iv) Clear felling of Daba bamboos.

These factors require to be checked on one hand and techniques are to be developed to improve the quality and quantity of the clumps in order to conserve the deteriorating Bamboo forests. Decreasing trend in production of Bamboo has already indicated the deterioration of Bamboo forest. Appropriate silvicultural techniques to manage the Bamboo forest will, therefore be essential in restoring the valuable Bamboo forests of the state.

Distinguishing Morphological characters of the culms of different age:

Culm age	Morphological character.
Karadi (the first year culm)	Culm sheath present on lower half of culm. Branches present through out the length of culm. Green uniformly, bloom is abundantly present and comes off easily on finger. A fresh cut just under the node shows the same fresh coloration even after one or two minutes
Kasi (the second year culm)	Culm sheath mostly absent except some remnances. Culm dark in colour. Branches present practically at all nodes. Bloom is patchy, grayish-white in colour and comes off less easily on finger. A fresh cut just under the node shows the same fresh coloration even after one or two minutes
Pakala (the 3rd & 4th year culm)	Culm sheath absent. White bloom absent. Blackish gray or dark blotches appear which come off on finger slightly on rubbing. A fresh cut under the node shows reddish-brown coloration after one or two minutes

SUPPLY OF BAMBOOS TO ARTISANS INCLUDING CO-OPERATIVE SOCIETIES (ORISSA) RULES, 1980.

In exercise of the powers conferred by clauses (c), (d) and (e) of Section 36 of the Orissa Forest Act, 1972 (Orissa Act 14 of 1972), the State Government do hereby make the following rules to control and regulate the granting of licenses to bamboo artisans including Co-operative Societies and felling and removing bamboos from protected forests located within the vicinity of the places where they are ordinarily resident, for purposes of trade namely:

1. Short title, extent and commencement: - (1) The rules may be called the Supply of Bamboos to Artisans including Co-operative Societies (Orissa) Rules, 1980.
2. They shall come into force on the date of their publication in the Official Gazette.
3. Definition: - In these rules, unless the context otherwise requires:-
   (i) "Act" means the Orissa Forest Act, 1972 (Orissa 14 of 1972);
   (ii) "Bamboo artisan" means a person who earns his livelihood or a Co-operative Society, the members of which earn their livelihood by making baskets, kullas, tatties, variety of containers and other articles made of bamboos for sale to general public;
   (iii) "Family" means the members of the family of bamboo artisans;
   (iv) "Form" means a form appended to these rules;
   (v) "Licensee" means any individual member of a family or Society registered under Rule 3 and is in possession of the licence book;
   (vi) "Permit" means a permit issued by an Authority competent to issue the same under these rules;
   (vii) "Schedule" means the Schedule appended to these rules;
   (viii) "Society" means a Bamboo Artisans' Co-operative Society registered under the Orissa Co-operative Society Act, 1962;
   (ix) "Value" means value of bamboos as per rate prescribed in the Schedule appended to these rules;
   (x) "Vicinity" means the area within the territorial Forest Range; but does not include a plantation area;

(xi) "Working month" means all the months of the calendar year except the months of July, August and September;

(xii) "Working season" means the period between Ist October to 30th June;

All words and expressions used in these rules but not defined therein have the same meaning as are respectively assigned to them in the Act.

3. Registration and licence:

(1) All the members of family or Society desirous of obtaining bamboos from protected forests for manufacture of bamboo products for purposes of trade shall be required to register themselves in the Territorial Forest Range Office within whose jurisdiction, they are ordinarily resident.

(2) The application for registration shall be in Form No.1 and shall be accompanied by an Identity Certificate in Form No.II issued by the Sarpanch of the Grama Panchayat or Ward Member of Municipality or Notified Area Council as the case may be of the area where the applicant is ordinarily resident (in case the applicant of a Society, the Identity Certificate in respect of all members of the Society shall be furnished).

(3) All applications received from members of family and Societies shall be serially entered in a register in Form No.III by the concerned territorial Forest Range Officer. The applications and Identity Certificate shall be filled in the Range Office.

(4) After registering the application, the Range Officer shall issue a printed licence book in Form No.IV to the licensee from whom the cost of licence book amounting to rupees two shall be realized and credited to forest revenue. An used up licence book when returned by the licensee, shall be replaced by a new one, free of cost, by the Ranger Officer.

(5) All the printed licence books shall bear machine serial number. A register of licence books shall be maintained in the Range Office in Form No.V.

4. Permit and scale of supply:

(1) Subject to such orders or directions of the State Government and

subject to availability in the protected forest, a licence may be granted permit during the working season up to five hundred and forty Salia bamboos.

(2) Not more than sixty Salia bamboos shall be permitted for removal in a working month under permit and not more than twenty bamboos shall be allowed at a time.

(3) The bamboos to be cut and removed under such permit shall not be less than two years old.

(4) The Forester or any Forest Officer superior to him having jurisdiction over the area can issue such permits on realization of value and presentation of the licence book by the licensee. Each issue of permit shall be duly entered in the licence book by the Forest Officer, with his initial and date.

(5) A permit shall be in Form VI. The permit books shall be in triplicate and each page of the permit book shall bear the serial number of the book and page number of the permit in print. The original permit shall be issued to the party; the duplicate copy to be sent by the issuing officer to the Range Officer along with accounts and the triplicate shall be retained as a counterfoil in the book.

4. **Value of bamboos:** The value payable for different forest divisions for the purpose of sub-rule (4) of Rule 4 will be as per rates indicated in the Schedule. These rates are for felling and removal of bamboos under permit.

5. **Restrictions:** While cutting bamboos, the cutting rules prescribed in the Working Plan of the Division shall be applicable for the purposes of this rule also.

6. **Other methods of supply and rates thereof:** The State Government may prescribe separate rates for different areas for the bamboos to be paid by the licensees when such bamboos are supplied for the purpose of these rules from departmentally opened depots.

7. **Infringement and penalty:** Infringement of any of the provisions of these rules by the licensee shall make him liable to forfeiture of the license besides such other action that may be taken under provisions of Section 37 of the Act.

SCHEDULE
(Rule 5)

Rate per single Salia bamboo payable by a licensee.

Name of the Division	Rate per single Salia bamboo
1. Phulbani	
2. Deogarh	
3. Bonai	
4. Rairakhol	43 paise
5. Bamra	
6. Sambalpur	
7. Kalahandi	
8. Khariar	
ALL OTHER DIVISIONS	
1. Angul	
2. Athagarh	
3. Baripada	
4. Baliguda	
5. Bolangir	
6. Dhenkanal	
7. Ghumsur (North)	65 paise
8. Ghumsur (South)	
9. Jeypore	
10. Keonjhar	
11. Karanjia	
12. Nowarangpur	
13. Nayagarh	
14. Puri	
15. Paralakhemundi	
16. Rayagada	
17. Sundargarh	

FORM I
[Rule 3 (2)]
APPLICATION FORM FOR REGISTRATION

(1) Name of the applicant

(2) Father's name

(3) Address

(4) Whether the applicant is a member of family of bamboo artisans/Bamboo artisans Co-operative Society.

(5) Number of members in the family with their names engaged in Bamboo handy work/names along with the name of president and the name of the Society.

(6) Monthly requirement of Salia Bamboos.

(7) Name of forest from where required.

Signature of the applicant

DECLARATION

I .... do hereby declare that the information furnished above are true and that myself and my family members are bamboo artisans are dependent on trade of bamboo articles at the means of livelihood.

Place :
Date :

Signature of the applicant

FORM II
[Rule 3 (2)]
Identity Certificate

This is to certify that Shri... son of Shri.................................. Village........................P.S................................ under ward No...........of ....Gram Panchayat/ N.A.C./ Municipality is a bamboo artisan with following family members of .... (Name) Society.......................... Consisting of .... members engaged in manufacture of bamboo products. The members of the family/Society are fully dependent on such trade for earning their livelihood. I have not granted similar certificate to this person or to any other member of his family or Society in the past.

Names of the member of the family or Society.

(1)

(2)

Signature of the Sarpanch/Ward Member
(Name in full)
Name of Grama Panchyat/ N.A.C.

Date..........................

FORM III

[Rule 3 (3)]

REGISTER OF APPLICATIONS FOR BAMBOO ARTISANS

Date	Name of Applicant	Village	Name of GP/ NAC	By whome identi-fied	Name of Mem-bers	Regn. No. of the applicant	Forest from which supply is required	No. of license book issued	Date of issue	Re-marks
					In the family society					
1	2	3	4	5	6	7	8	9	10	11

FORM IV

[Rule 3 (4)]

Price of book – Rs.2 (Rupees two) only

LICENCE BOOK (FOR BAMBOO ARTISANS)

Book No. ....

Name of Range ....,..

Name of Division ....

Name of Licensee ....

His signature or thumb
Impression ....

These details should be printed on the front page of the licence book

Form inside the book

Date	Permit No.	From which forest supply is permitted and figure	No. of Salia bamboos permitted (in words and figures)	Initials of the issuing officer
1	2	3	4	5

FORM V
[Rule 3 (5)]

REGISTER OF LICENCE BOOKS

Date of receipt of books	Name of serial number of books	Date of issue to license	Machine No. of license book issued	Name and address of license to whome issued	Date of return of the book after use	Intials of the issuing officer
1	2	3	4	5	6	7

FORM VI
[Rule 4 (5)]

BAMBOO PERMIT
FOREST DEPARTMENT, ORISSA

Book No.__________ Permit No. __________

Name of the licensee ____________________

Address ____________________

Number of Salia bamboos permitted for Removal (in words and figures) __________

____

Value paid (in figures and words) ____________________

Name of protected forests from where removal is permitted __________

____

Date of issue __________ Date of expiry of the permit __________

Signature of Issuing Officer

Date __________

NOTE - Bamboo cutting rules prescribed for the Reserved Forests of the division shall be observed while cutting bamboos in Protected Forests under these rules.

BANKABLE SCHEMES FOR CULTIVATION OF BAMBOO

COST OF BAMBOO (Bambusa vulgaris / B. nutans) CULTIVATION IN ONE HECTARE OF WASTELAND

SPACING : 6M x 6M — WAGE RATE : Rs. 52.5

NO. OF TREES/HA : 278 — CASUALTY REPLACEMENT : 20%

SURVIVAL/HA @ 80% 222

Sl. No.	PARTICULARS OF WORKS	UNIT	COST (RS.) PER YEAR						TOTAL
			1	2	3	4	5	6	
1	Site preparation	10 MD	525						525
2	Alignment & staking	2 MD	105						105
3	Digging of pits (60x60x60cm) and refilling of pits after mixing FYM, Fertiliser and insecticide (12 pits/MD & 30 pits/MD)	30 MD & 6 MD	1575	315					1890
4	Cost of FYM @ 5Kg/pit	250 Rs./ton	348						348
5	Cost of fertiliser @ SSP 200 gms as basal and NPK 50, 200, 300, 400, 500 gms per clump in 1st, 2nd, 3rd, 4th, 5th year & onwards		347	500	750	1000	1250		3847
6	Cost of insecticides	LS	500	500					1000
7	Cost of plants including transportation (278,55)	7.5 Rs. per plant raised from culm cutting	2085	413					2498
8	Planting & replanting	10 MD 2 MD	525	105					630
9	Weeding (3,2)	5 MD per weeding	787.5	525					1313
10	Soil working, saucer pan enlargement, heaping earth (1 working in 1st year & 2 workings thereafter)	10 MD per working	525	1050	1050	1050	1050		4725
11	Tending, cleaning & harvesting of culms per year	10 MD in 4th year 20 MD in 5th year 30 MD in 6th year				525	1050		1575
12	Protective Irrigation (3 summer months, 1st yr covering all plants & 2nd yr replaced plants)	210 Rs./Irrigation	4200	840					5040
13	Fencing (Live hedge) and maintenance	4 Rs./Rmt 1 Re./Rmt	1600	400					2000
	SUB-TOTAL	Rs.	13122	4648	1800	2575	3350		25495
	CONTINGENCY 3%	Rs.	394	139	54	77	101		765
	GRAND TOTAL	Rs.	13516	4787	1854	2652	3451		26259
								SAY	26300

UNIT COST : 26300 Rs. (Cost for the 1st five years)

Technical Parameters

A. Yield and Income

SALE RATE OF BAMBOO CULMS 30 RUPEES/CULM

YEAR	CULMS/ CLUMP	TOTAL NO. OF CULMS	TOTAL INCOME
5	2	444	13320
6	3	666	19980
7	4	888	26640
8	6	1332	39960
9	8	1776	53280
10th onwards	10	2220	66600

B. Spacing : 6m x 6m

C. Rate of Survival : 80%

D. Casualty replacement : 20% in 2nd year.

E. Harvesting will start from 5th year and from 10th year the yield will stabilise.

F. Cash flow has been shown upto 15 years for the purpose of financial analysis & repayment schedule have been shown upto 8 years as the loan is fully repayable out of income upto 8 years.

G. Intercroping can be taken in initial 2-3 years with oilseeds, pulses etc.

CASH FLOW

YEAR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 COST	13516	4787	1854	2652	3451	3991	2704	3515	3515	3515	3515	3515	3515	3515	3515
2 BENEFITS					13320	19980	26640	39960	53280	66600	66600	66600	66600	66600	66600
3 NET BENEFITS	-13516	-4787	-1854	-2652	9870	15989	23936	36445	49765	63085	63085	63085	63085	63085	63085

IRR 41.44%

NPV 80087

BCR 3.90 : 1

V. REPAYMENT SCHEDULE

TFA 23700

Interest Rate 12%

YEAR	1	2	3	4	5	6	7	8
LOAN	12160	4310	1670	2390	3110	0	0	0
LOAN OUTSTANDING	12160	16470	18140	20530	23640	21640	17640	11640
INTEREST	1459	1976	2177	2464	2837	2597	2117	1397
INTEREST O/S	1459	3436	5612	8076	10913	10510	7626	2023
REPAYMENT - PRINCIPAL					2000	4000	6000	11640
REPAYMENT - INTEREST					3000	5000	7000	2023
REPAYMENT - TOTAL					5000	9000	13000	13663
GROSS SURPLUS					13320	19980	26640	39960
NET SURPLUS					8320	10980	13640	26297

Repayment period 8 years

Grace period 4 years

COST OF TEAK + BAMBUSA VULGARIS / B. NUTANS CULTIVATION IN ONE HECTARE OF WASTELAND

SPACING : Teak - 2.0m x 2.0m, Bamboo - 10m x 10m — WAGE RATE : Rs. 52.5

NO. OF TREES/HA : Teak : 2000 (excluding 400 Teak trees @ 4 trees immediate to each bamboo clump which will not be planted to avoid supression)
Bamboo : 100

SURVIVAL/HA @ 80% Teak : 1600
Bamboo : 80

CASUALTY REPLACEMENT : 20%

Sl. No.	PARTICULARS OF WORKS	UNIT	COST (RS.) PER YEAR						TOTAL
			1	2	3	4	5	6	
1	Site preparation	10 MD	525						525
2	Ploughing	LS	600						600
3	Alignment & staking	4 MD	210						210
4	Digging of pits (45x45x45cm) and refilling of pits after mixing FYM, Fertiliser and insecticide	125 MD & 25 MD	6562.5	1312.5					7875
5	Cost of F.YM @ 3Kg/pit for Teak and 5Kg/pit for Bamboo	250 Rs./ton	1625						1625
6	Cost of fertiliser : Teak @ 50 gms NPK as basal and 50 DAP in 1st, 2nd & 3rd year.		1900	1000	1000				3900
	Bamboo @ SSP 200 gms as basal & NPK 50,200,300,400,500 gms per clump in 1st, 2nd, 3rd, 4th, 5th year & onwards		125	180	270	360	450		1385
7	Cost of insecticides/pesticides	LS	500	500	500	500			2000
8	Cost of plants including transportation	3 Rs. per Teak presprouted stump	6000	1200					7200
		7.5 Rs. per Bamboo plant raised from culm cutting	750	150					900
9	Planting & replanting	20 MD 4 MD	1050	210					1260
10	Weeding (2,2,1)	16 MD per weeding	1680	1680	840				4200
11	Soil working (1,2,2)	16 MD per working	840	1680	1680				4200
12	Tending, cleaning & harvesting of culms	5 MD in 4th year 10 MD in 5th year				262.5	525		788
13	Protective Irrigation during 3 summer months	LS	2000	1000	1000				4000
14	Fencing (Live hedge) and maintenance	4 Rs./Rmt 1 Re./Rmt	1600	400					2000
	SUB-TOTAL	Rs.	25968	9313	5290	1123	975		42668
	CONTINGENCY 3%	Rs.	779	279	159	34	29		1280
	GRAND TOTAL	Rs.	26747	9592	5449	1156	1004		43948
								SAY	43900

UNIT COST : 43900 Rs. (Cost for the 1st five years)

Technical Parameters

A. Yield and Income

	Teak						Bamboo			Teak + Bamboo
Year	No. of trees surviving	No. of trees removed	No. of saleable trees/ volume	Rate/unit (Rs.)	Income (Rs.)	Years	Culms/ clump	Total no. of culms	Income @ Rs. 30/- per culm	Total Income (Rs.)
						5	2	160	4800	4800
						6	3	240	7200	7200
7	1600	800	800 poles	80	64000	7	4	320	9600	73600
						8	6	480	14400	14400
						9	8	640	19200	19200
						10 & onwards	10	800	24000	24000
						11	10	800	24000	24000
						12	10	800	24000	24000
						13	10	800	24000	24000
14	800	400	400 poles	250	100000	14	10	800	24000	124000
						15-19			120000	120000
20	400	200	45 cum	9000/cum	405000	20	10	800	24000	429000
						21-29			216000	216000
30	200	200	72 cum	17000/cum	1224000	30	10	800	24000	1248000

B. Spacing : Teak - 2.0m x 2.0m, Bamboo - 10m x 10m

C. Rate of Survival : 80%

D. Casualty replacement : 20% in 2nd year.

E. Harvesting will start from 5th year and stabilise from 10th year in Bamboo and in case of Teak harvesting will be done in 7th, 14th, 20th and 30th year

F. Cash flow has been shown upto 14 years for the purpose of financial analysis & repayment schedule have been shown upto 8 years as the loan is fully repayable out of income upto 10 years.

G. **Intercropping can be taken in initial 2-3 years with oilseeds, pulses etc.**

CASH FLOW

YEAR	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1 COST	26747	9592	5449	1156	1004	1004	1004	1004	1004	1004	1004	1004	1004	1004
2 BENEFITS					4800	7200	73600	14400	19200	24000	24000	24000	24000	124000
3 NET BENEFITS	-26747	-9592	-5449	-1156	3796	6196	72596	13396	18196	22996	22996	22996	22996	122996

IRR 25.53%

NPV 35296

BCR 1.94 : 1

V. REPAYMENT SCHEDULE

TFA 39500

Interest Rate 12%

YEAR	1	2	3	4	5	6	7
LOAN	24070	8630	4900	1040	900	0	0
LOAN OUTSTANDING	24070	32700	37600	38640	39540	39540	39540
INTEREST	2888	3924	4512	4637	4745	4745	4745
INTEREST O/S	2888	6812	11324	15961	20706	24451	27196
REPAYMENT - PRINCIPAL					0	0	39540
REPAYMENT - INTEREST					1000	2000	27196
REPAYMENT - TOTAL					1000	2000	66736
GROSS SURPLUS					4800	7200	73600
NET SURPLUS					3800	5200	6864

Repayment period 7 years

Grace period 4 years

COST OF EUCALYPTUS + BAMBUSA VULGARIS/B.NUTANS CULTIVATION IN ONE HECTARE OF WASTELAND

SPACING : Eucalyptus - 2.0m x 2.0m, Bamboo - 10m x 10m   WAGE RATE : Rs. 52.5

NO. OF TREES/HA : Eucalyptus : 2000 (excluding 400 Eucalyptus tree @ 4 trees immediate to each bamboo clump which will not be planted to avoid supression)

Bamboo : 100

SURVIVAL/HA @ 80 Eucalyptus : 1600   Casualty replacement : 20%

Bamboo : 80

Sl. No.	PARTICULARS OF WORKS	UNIT	COST (RS.) PER YEAR						TOTAL
			1	2	3	4	5	6	
1	Site preparation	10 MD	525						525
2	Ploughing	LS	600						600
3	Alignment & staking	4 MD	210						210
4	Digging of pits (30x30x30cm) for Eucalyptus and (45x45x45cm) for Bamboo and refilling of pits after mixing FYM, Fertiliser and insecticide (12 pits/MD & 30 pits/MD)	37 MD & 8 MD	1942.5	420					2363
5	Cost of FYM @ 3Kg/pit for Eucalyptus and 5 Kg/pit for Bamboo	250 Rs./ton	1625						1625
6	Cost of fertiliser : Eucalyptus @ 100 gms NPK and 50 gms DAP in 1st year.		2800						2800
	Bamboo @ 200 gms SSP as basal & NPK 50,200,300,400,500 gms per clump in 1st, 2nd, 3rd, 4th, 5th year & onwards		125	180	270	360	450		1385
7	Cost of insecticides/pesticides	LS	500	500					1000
8	Cost of plants including transportation	2 Rs. per Eucalyptus & 7.5 Rs. per Bamboo plant raised from culm cutting	4000 750	800 150					4800 900
9	Planting & replanting	20 MD 4 MD	1050	210					1260
10	Weeding (2,2,1)	16 MD per weeding	1680	1680	840				4200
11	Soil working (1,2,2)	16 MD per working	840	1680	1680				4200
12	Tending, cleaning & harvesting of culms	5 MD in 4th year 10 MD in 5th year				262.5	525		788
13	Protective Irrigation (3 summer months)	LS	2000	1000					3000
14	Fencing (Live hedge) and maintenance	4 Rs./Rmt 1 Re./Rmt	1600	400					2000
	SUB-TOTAL	Rs.	20248	7020	2790	623	975		31655
	CONTINGENCY 3%	Rs.	607	211	84	19	29		950
	GRAND TOTAL	Rs.	20855	7231	2874	641	1004		32605
								SAY	32600

UNIT COST : 32600 Rs. (Cost for the 1st five years)

<u>Technical Parameters</u>

A. Yield and Income

	Eucalyptus					Bamboo		30	Eucalyptus + Bamboo
Year	Items	Yield	Rate/unit (Rs.)	Income (Rs.)	Years	Culms/ clump	Total no. of culms	@ Rs. 30/- per culm	Total Income (Rs.)
					5	2	160	4800	4800
					6	3	240	7200	7200
					7	4	320	9600	9600
8	(i) Poles @ 40% of surviving trees	640 nos	80/Pole	51200	8	6	480	14400	92800
	(ii) Pulp wood	24 ton	1000/ton	24000					
	(iii) Fuel wood	6.4 ton	500/ton	3200					
					9	8	640	19200	19200
					10 & onwards	10	800	24000	24000
					11	10	800	24000	24000
					12	10	800	24000	24000
					13	10	800	24000	24000
14	(i) Poles @ 40% of surviving trees	512 nos	80/Pole	40960	14	10	800	24000	87360
	(ii) Pulp wood	19.2 ton	1000/ton	19200					
	(iii) Fuel wood	6.4 ton	500/ton	3200					

B. Spacing : Eucalyptus - 2.0m x 2.0m, Bamboo - 10m x 10m

C. Rate of Survival : 80%

D. Casualty replacement : 20% in 2nd year.

E. Harvesting will start from 5th year and from 10th year the yield will stabilise.

F. Cash flow has been shown upto 8 years for the purpose of financial analysis & repayment schedule have been shown upto 8 years as the loan is fully repayable out of income upto 8 years.

G. Intercropping can be taken in initial 2-3 years with oilseeds, pulses etc.

CASH FLOW

YEAR	1	2	3	4	5	6	7	8
1 COST	20855	7231	2874	641	1004	1004	1004	1004
2 BENEFITS					4800	7200	9600	92800
3 NET BENEFITS	-20855	-7231	-2874	-641	3796	6196	8596	91796

IRR 22.25%

NPV 11947

BCR 1.43 : 1

V. REPAYMENT SCHEDULE

TFA 29300

Interest Rate 12%

YEAR	1	2	3	4	5	6	7	8
LOAN	18770	6510	2590	580	900	0	0	0
LOAN OUTSTANDING	18770	25280	27870	28450	29350	28350	27350	25350
INTEREST	2252	3034	3344	3414	3522	3402	3282	3042
INTEREST O/S	2252	5286	8630	12044	15566	16968	16250	14292
REPAYMENT - PRINCIPAL					1000	1000	2000	25350
REPAYMENT - INTEREST					2000	4000	5000	14292
REPAYMENT - TOTAL					3000	5000	7000	39642
GROSS SURPLUS					4800	7200	9600	92800
NET SURPLUS					1800	2200	2600	53158

Repayment period 8 years

Grace period 4 years

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